fire in the united states

Deaths, Injuries, Dollar Loss, and Incidents at

the National, State, and Local Levels in 1983

sixth edition

Federal Emergency Management Agency

FIRE IN THE UNITED STATES

Sixth Edition

FEDERAL EMERGENCY MANAGEMENT AGENCY

UNITED STATES FIRE ADMINISTRATION

ACKNOWLEDGEMENT

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INTRODUCTION

"Eternal vigilance is the price of liberty."[1] It is also the price of fire safety. Fire—as a national problem—can lash out against Americans with ferocious vigor. Unless carefully watched, the fire problem looms large for the nation. And, unless regularly monitored, a seemingly corrected fire problem can resume its course of fury. In short, freedom from fire danger can only be realized when individuals learn to apply the fundamental disciplines of fire prevention.

Within the past ten years, a number of advances have been made in fire safety. Improvements in fire fighter training, standard operating procedures, building codes, consumer product regulation, public education and awareness have all contributed significantly. Despite these accomplishments, however, the most important tasks facing today's fire service remain the development of new and refined prevention methods. For these reasons, the U.S. Fire Administration has selected *prevention* as the central theme of the sixth edition of *Fire in the United States*—both to commend recent achievements in fire safety and to point to the need for continued program improvements.

This sixth edition of *Fire in the United States*—as in past years—describes key features of the nation's fire problem. It includes detailed discussions on fire incidence, deaths, injuries, and losses to fire fighters and civilians. The sixth edition also addresses trends and, to the extent possible, forecasts the U.S. fire problem.

The value of any report rests largely on the quality of its data. In recent years, the U.S. Fire Administration has made tremendous strides in the development and refinement of its uniform data base—the National Fire Incident Reporting System. The effects of these advancements are apparent in the sixth edition of *Fire in the United States*. This edition bears the fruit of a substantial base of data: much of its contents are the result of the contributions of over 10,000 fire departments in reporting jurisdictions—participating states, municipalities, and the District of Columbia.

Information is a fundamental tool of progress. Hence, the significance of the data obtained from the National Fire Incident Reporting System (NFIRS) cannot be over emphasized. NFIRS data have provided an opportunity for analysts to fine-tune their knowledge about fire incidence and have assisted in their abilities to pose important questions and propose useful hypotheses. As analysts' understanding of the fire problem has improved so, too, have the abilities of policymakers and administrators to tailor programs to meet the actual needs of the fire service and civilian populations.

The U.S. Fire Administration commends the thousands of NFIRS participants located in fire departments across the United States for their valuable reports and encourages nonparticipants to become actively involved in this important project. As always, the U.S. Fire Administration appreciates all organizations and individuals who assisted in the preparation of this report. Fire prevention is a joint endeavor; without a sound base of mutual cooperation and shared expertise, little can be done to correct the nation's fire problem.

The United States Fire Administration also thanks the National Fire Information Council (NFIC) for its cooperation and support in the preparation of this report. NFIC is the professional association of the National Fire Incident Reporting System (NFIRS) program managers. NFIC is a voluntary association of jurisdictions participating in the NFIRS system. NFIC serves as the focal point for NFIRS-related activities, including

[1]John Philpot Curran, an Irish judge in a speech in Dublin, Ireland in 1790.

conferences, technical support to NFIC member jurisdictions, and development and implementation of changes to the NFIRS system.

ABOUT THE FORMAT

The sixth edition of *Fire in the United States* has been given a fresh coat of paint and a new look. These changes in format were made specifically with the readers in mind. The readers of *Fire in the United States* constitute a very broad audience—professionals and laypersons alike, drawn together by their common interest in the nation's fire problem. Taking this into consideration, this edition was carefully designed to be both informative and interesting to all types of readers.

Several explanatory comments on the format of this new edition may be helpful to our readers. Perhaps of primary importance, the sixth edition emphasizes two features:

Ranking Strips - used to illustrate and describe fire problems for readers who are less familiar with the analysis of fire data and as a quick frame of reference for those without expertise in this area;

Scenario and Single Factor Analyses - while not new concepts, these analyses are given increased emphasis in this edition and are presented as an important means of conveying causal information about fire incidence to all types of readers.

The use and application of these methods of analysis are explained in the following sections. **Readers unfamiliar with fire analysis are urged to review the following sections carefully and to refer back to them throughout the reading of this edition; not only will this enhance comprehension of material contained in this report, but it also will expand the reader's general understanding of fundamental concepts of fire analysis.**

Ranking Strips - Ranking strips are included throughout this edition to illustrate two important types of measurement used to study the fire problem: *absolute* measures and *relative* measures.

The nation's fire problem is commonly analyzed by using four *absolute* measures:

- the number of fires;
- the number of fire-related deaths;
- the number of fire-related injuries; and
- the amount of direct property loss that occurs.

These numbers enable analysts to measure the size of the fire problem. For example, to determine how large the fire problem is in New York, analysts can look at the reported numbers for each of these four measures and can draw some conclusions regarding the general magnitude of the state's fire activity.

Absolute measures have some intrinsic limitations. They are quite valuable as frequency measures—providing information on the number of occurrences of a particular value or category. However, *absolute* measures can only be used to compare the tangible characteristics of a fire; they *cannot* be used to examine the amount of pain and suffering

that may have resulted from a particular fire, nor do they allow comparisons of personal risk of fire death and injury. But, absolute measures are the first method available for rationally and objectively measuring one fire problem against another. These numbers also can be used to compare the size of the fire problem with other societal problems; e.g., crime, accidents, disease, and natural disasters.

Another tool of fire analysis is *relative* measures. These are necessary in order to make valid comparisons of components of the fire problem. In this edition of *Fire in the United States*, the following *relative* measures are used:

- the number of fire-related deaths per 1,000,000 population per year;
- the number of fire-related injuries per 1,000,000 population per year;
- the amount of direct property loss per fire per year;
- the number of deaths per 1,000 fires per year; and
- the number of injuries per 1,000 fires per year.

To understand the usefulness of *relative* measures, consider the fire experience of two highly dissimilar states—New York and Alaska—as examples. New York's large population suggests that New York will always have more fire deaths per year than Alaska, where very few people reside. Comparing the two states' fire activity by *absolute* measures, then, is of fairly limited application. *Relative* measures, however, enable analysts to compare, by state, elements of fire incidence. By looking at the relative number of fire deaths per 1,000,000 population per year, we learn that New York had 29.2 and Alaska had 61.6. Even though New York has substantially more fire deaths than Alaska in any given year (516 vs. 27 for 1983), relative measures enable us to see that the risk of death from fire in Alaska is considerably higher.

In short, the method of analysis to be used—absolute or relative—depends on the question to be addressed: *absolute* numbers measure the size of a given problem and *relative* numbers compare otherwise dissimilar aspects of the fire problem; i.e., what is a more critical element of the fire problem in New York State—deaths from smoking-related fires or from "space heater" fires? When the size and nature of a problem is isolated, analysts are able to evaluate program efforts and determine where they can be most effectively placed. It is through this process, then, that fire prevention can be realistically accomplished.

The ranking strips contained in this edition of *Fire in the United States* provide absolute and relative measures for several aspects of the fire problem, including, where practical, by subject area, by state, and by region. The ranking strips will assist readers in making comparisons—and judgments—at a glance.

Single Factor Analysis - the use of single factor analysis is particularly useful as a means of highlighting a specific type of fire problem. It also can provide another approach to analyzing the fire problem—by isolating unique elements. For example, single factor analysis would allow the fire analyst to determine the top three ignition factors in a particular state. Section Eight of this report, which examines 1983 fire experience by geographic region, is formulated through the use of single factor analyses. With this method, the reader can turn to the particular page about his or her state and quickly determine the ignition factors contributing to the largest number of fires in that particular state. While a wide variety of single factor analyses are possible, Section Eight

focuses on: equipment involved, materials ignited, and ignition factors.

Scenario Analysis - serves as a particularly significant tool for understanding and planning corrections for the nation's fire problem. Analysts have long known that a fire is not actually caused by a single factor but is the result of a chain of circumstances that results in a fire incident. In turn, analysts recognize that fire incidents can be prevented when one or more links in this chain of events are broken. A *scenario* is an abbreviated description of a specific chain of events that causes a particular outcome—that is, a fire-related death, injury, property loss, or other incident.[2]

A scenario can be drawn for any fire by describing the nature of the loss that it causes and the particular events that encompass it. Typically, several characteristics can be utilized, such as:

- type of loss - fire-related death, injury, and/or property;
- type of occupancy - residential structural, mobile property, public assembly, or other categories of fixed or mobile property uses;
- time of incident - day or night;
- ignition source - smoking, electrical appliances, and so forth;
- item ignited - clothing, bedding, and other agents of spread; and
- direct cause of loss - smoke and gas, heat and flame.

To illustrate how these characteristics are put into play, consider a man who—after smoking in bed—dies from the effects of a smoldering mattress fire. Using the preceding six characteristics, the following scenario could be constructed for this incident: 1) *type of loss* - death; 2) *type of occupancy* - residence; 3) *time of incident* - night; 4) *ignition source* - smoking; 5) *item ignited* - furnishings; and 6) *direct cause of loss* - smoke and gas. Once this scenario has been constructed, consideration can be given to find a means for preventing this outcome in future incidents. For example, had the man not been smoking in bed or had the man been sleeping on a fire-retardant mattress, the type of loss which occurred in this incident presumably would not have been death.

There are a multitude of different scenarios for fire incidents. The task at hand for fire analysts is to identify and rank those which are most prominent in causing fire loss. In recent years, as the NFIRS data base has expanded, analysts at the U.S. Fire Administration have been able to construct and rank the top scenarios in many categories of the fire problem. The U.S. Fire Administration is pleased to provide readers with this very important analytical tool.

Beyond these elements, the sixth edition has also incorporated a more lively style of text and graphics. A report that can't be easily understood is not particularly useful. Hence, the writing style in this edition is direct and conversational. We have avoided the use of technical terminology. Where practical, we have followed the formula of the American journalist, responding to the traditional query—"what; where; when; who; and why." We hope you will share our enthusiasm for these changes. As always, the U.S. Fire Administration welcomes your comments and suggestions.

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[2]For a dramatic illustration of a chain of events that led to a specific fire, see the Summary of Findings section.

ABOUT DATA SOURCES

Fire information is derived from a variety of sources. As we mentioned earlier, much of the content in *Fire in the United States* is based on data obtained from the **National Fire Incident Reporting System (NFIRS)**, maintained by the U.S. Fire Administration Office of Fire Data and Analysis. NFIRS information is based on data submitted by some 10,000 fire departments who routinely file individual reports for each fire occurring in their jurisdictions. These fire departments collect information on a uniform set of key data elements. Standardized terminology, based on the NFPA 901 Standard, *Uniform Coding for Fire Protection*, is used. These reports are sent to State fire marshals where the data are entered on computer tape. A copy of the tape is then forwarded to the U.S. Fire Administration for analysis.

The National Fire Incident Reporting System was established in the U.S. Fire Administration, in the Federal Emergency Management Agency, to provide a central entity for the collection of uniform fire data. NFIRS jurisdictions that participated in the 1983 report are:

- Alaska
- California
- Colorado
- Connecticut
- Delaware
- District of Columbia
- Florida
- Hawaii
- Idaho
- Illinois
- Iowa
- Kansas
- Louisiana
- Maryland
- Michigan
- Minnesota
- Montana
- New Jersey
- New York
- Ohio
- Oregon
- Rhode Island
- South Carolina
- South Dakota
- Tennessee
- Texas
- Utah
- Virginia
- Washington
- West Virginia
- Wisconsin
- Wyoming

In addition to NFIRS, the U.S. Fire Administration provides financial support for several other important fire analysis projects noted in relevant sections of the report.

Other principal data sources are described below:

The Offices of the State Fire Marshals. In each of the 50 states, a fire marshal or commission is charged with the prevention of fires. Other duties include such tasks as fire inspections, fire safety, and the collection and maintenance of data concerning State fire problems.

State Fire Marshals' Offices have provided an important, supplemental source of data for *Fire in the United States*. Most sections of the report contain figures and tables solely based upon NFIRS data. However, the exclusive use of NFIRS data precludes the use of data in those states not currently participating in NFIRS. For some topics, such as the number of fire deaths in the United States, we have chosen to include data from every state, whether an NFIRS participant or not. In these instances, the Offices of the State Fire Marshals have provided invaluable, State-specific information.

The National Fire Protection Association. Each year, the National Fire Protection Association (NFPA), collects incident data on multiple death fires, large property loss fires, and fire fighter fatalities. These projects, funded in part by the U.S. Fire Administration, provide a valuable data source for these important topics. As in prior years, NFPA data related to these subjects have been used in sections of *Fire in the United States*.

The Fire Incident Data Organization. This data system, known as FIDO, is operated by NFPA. The system collects in-depth information on particularly severe fires of high technical interest. Selection criteria include incidents in non-residential fires causing one or more deaths, residential fires resulting in two or more deaths, and all fires resulting in a loss in excess of $500,000. All incidents involving fire fighter fatalities are also included. The system is used to produce the annual multiple death and large loss studies referred to above and for specialized analysis of other fire problems.

The National Center for Health Statistics and the Consumer Product Safety Commission. The U.S. Fire Administration historically has relied upon these two agencies as important sources of information on fire-related topics. Tallies of fire death certificate data—a means of estimating the annual number of civilian deaths by fire in the U.S.—have been particularly important.

chapter 2

summary of findings

SUMMARY OF FINDINGS

Fire is a national problem. The speed with which a serious fire can unleash its dramatic devastation is virtually unparalleled. And, the number of times that serious fires occur in any given year is of startling magnitude. The following description—based on an actual, intentionally-set, test fire begins to illustrate why:

A lighted cigarette is dropped between the cushions of a couch. There is no immediate sign of fire, no visible smoke, no tangible heat rising from the spot where the cigarette was dropped. Forty-five minutes go by, then an hour. The cigarette is warming; then it is igniting particles of dust and thread found in the couch. The cushions hold the heat, and the temperature rises. There is a faint stirring of air over the crevice between the cushions of the couch followed by a thin column of smoke. A puff of smoke belches upward accompanied by a small, thin flame. The flame spreads rapidly across the cushions because they have been pre-warmed by the smoldering cigarette.

In less than a minute after the first flame appeared, the entire couch is engulfed in flames. Within two minutes the fire has spread to other furnishings in the room. The temperature near the ceiling is approximately 1,700 degrees Fahrenheit. Nearer to the floor, the temperature is 700 degrees Fahrenheit. No human being could now survive in the room. Smoke, toxic gases, and heat from the fire spread to the other rooms. Closed doors between rooms slow the fire's spread slightly. However, a combustible finish on the walls and ceiling accelerates the fire's progress and increases its potential to do serious injury.

In the room of the fire's origin, "flash-over" has occurred.[3] The hot gases near the ceiling have ignited, and everything that can burn is now burning. At places throughout the room, the temperature now exceeds 3,000 degrees Fahrenheit. In other rooms, including remote bedrooms, furnishings burn. In these distant rooms, temperatures are in excess of 1,200 degrees Fahrenheit. Even assuming someone could survive the tremendous heat, toxic gases are now present that will kill any occupants. It is less than five minutes since the first visible flame appeared.[4]

Every day an average of 6,800 fires occur, all having the potential to create severe loss.

In 1973, a national commission was assembled to address the problem of fire in America. The National Commission on Fire Prevention and Control measured the problem in terms of the tremendous human suffering and loss of life and property that have resulted from fires in the United States. The Commission determined that an effective fire fighting strategy required, among other items, the development of a solid base of research and a national system for data collection and analysis to assist local fire services to establish effective programs. The U.S. Fire Administration has worked to meet these important goals since the Agency's inception in 1978.

The U.S. Fire Administration has estimated that there were 2.4 million fires reported to fire departments in the nation in 1983. The destruction wrought by these fires is readily apparent from the following statistics: over 6,000 fire-related deaths, over 100,000

[3]Flash-over refers to the phenomenon which occurs when a fire grows and heat builds until a point is reached where all combustible materials not yet burning reach their ignition temperature and begin burning simultaneously.

[4]Based on a description presented in *NFPA Quarterly* (1959); p. 300-301.

fire-related injuries, and more than $8 billion in direct property loss are estimated to have occurred from the nation's reported fires in 1983.[5]

FIRE PROBLEMS IN THE UNITED STATES, 1983
A RANKING STRIP

Estimated Number of Fires	Deaths	Injuries	Property Loss	Deaths Per 1,000 Fires	Injuries Per 1,000 Fires	Property Loss Per Fire
2,400,000	6,100	110,000	$8,400,000,000	2.5	45	$3,500

Source: U.S. Fire Administration

Table 2.1

Despite these large numbers, it was a better than average year for the nation. The U.S. Fire Administration attributes this fact to increased public awareness, improved intervention strategies, and refinements in interagency cooperation in the field of public safety.

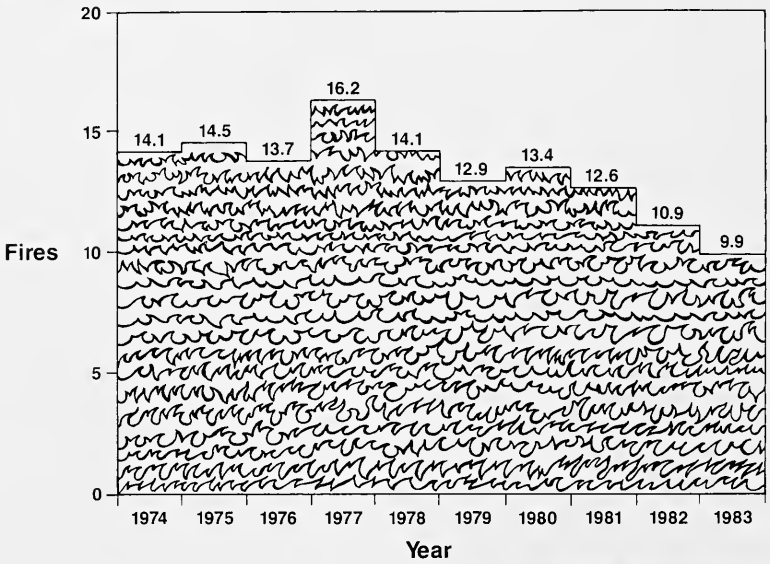
1983 U.S. FIRE LOSSES

Bear in mind while reviewing the following summary—and in subsequent sections of this report—that data collection and analysis of the national fire problem remain a comparatively new undertaking. In less than ten years, the U.S. Fire Administration has developed a standardized reporting system that has been applied nationwide. Prior to that time, there was no uniform reporting and data collection. Refinements in research collection and methodology are an ongoing process. In light of this, there are some intrinsic limitations in comparing 1983 data from prior years.

[5]Unfortunately no one knows exactly how much property loss results from fires. Several agencies, including the U.S. Fire Administration, have made estimates. While there are no 100 percent counts of loss, these estimates are believed competent.

In the past few years, the number of fires has decreased slightly. When relative measures are applied, further reductions are evident. The rate of fires per capita has experienced a substantial decrease; however, this pattern is partially attributable to an increasing population.

U.S. FIRE RATES PER THOUSAND POPULATION



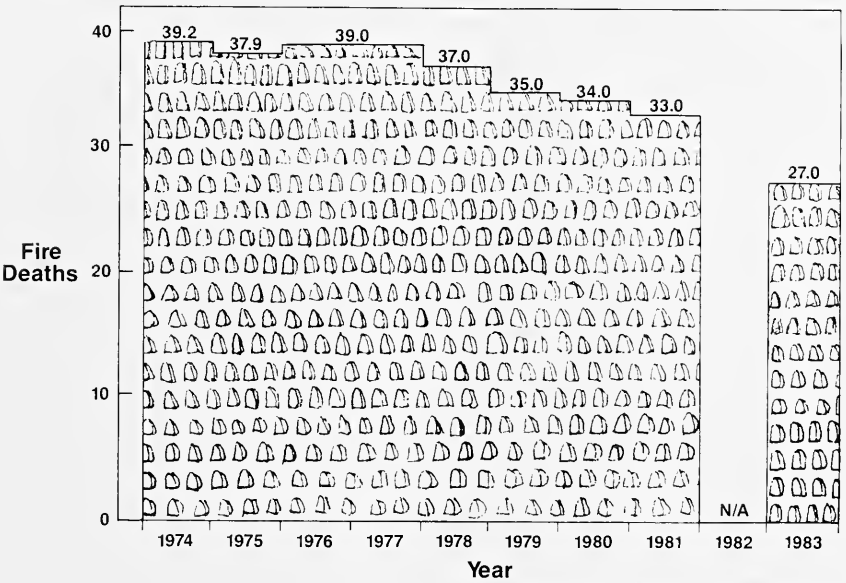
Source: U.S. Fire Administration

Figure 2.1

TRENDS IN FIRE DEATHS

Fire death rates among civilians and fire fighters have decreased slightly over the past several years. In turn, the actual risk of death by fire has decreased even more because the population of the United States has increased slightly during the past year. Despite this pattern, the number of deaths and the risk of death from fire remain far too high. Much lower death rates have been achieved in other countries and in selected regions of this nation. Considerably more work needs to be done to reduce fire-related deaths throughout the United States.

U.S. FIRE DEATHS PER MILLION POPULATION



Source: Fire Deaths—U.S. Fire Administration
Population—U.S. Census Bureau

Figure 2.2

Certain identifiable groups in the general population of the U.S. face much higher risk of dying by fire than others. Young children and the elderly have disproportionately high fire death rates. Men are about twice as likely to die from fire than are women. Blacks and Native Americans have extremely high fire death rates. In turn, Chinese, Japanese, and other Asians tend to have lower rates of fire-related death than the general population. Fire fighters, quite understandably, face a very substantial risk of death by fire.

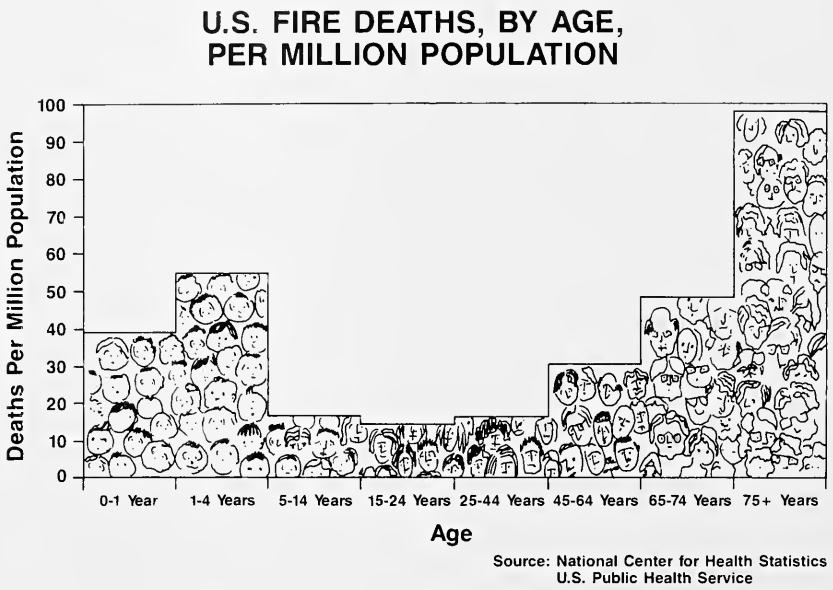


Figure 2.3

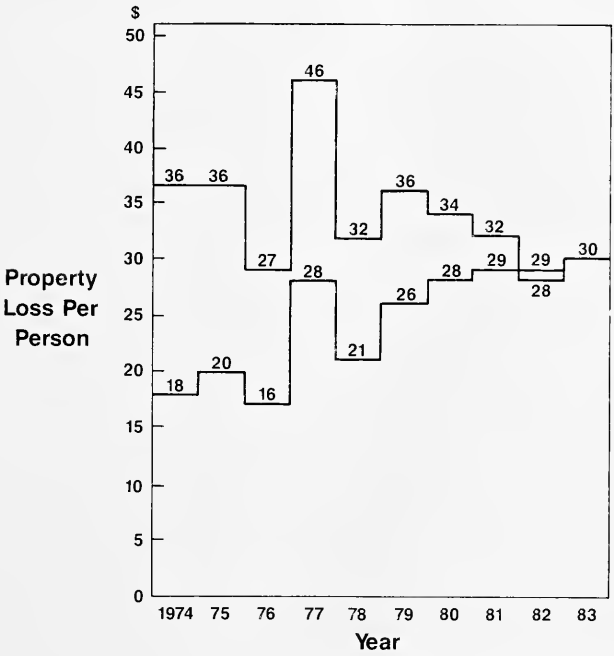
TRENDS IN FIRE INJURIES

Trends in fire-related injuries are difficult to track. Reporting of injuries has continued to be an uneven process, and methods of data collection are, at best, imprecise. Of the 760,939 actual fire incidents reported to the National Fire Incident Reporting System in 1983, 25,705 injuries (12,576 injured fire fighters and 13,129 injured civilians) were reported. This compared to 23,128 injuries (11,345 injured fire fighters and 11,783 injured civilians) in 708,129 fires reported in 1982. As in other years, analysts believe that 1983 injury rates, particularly among civilians, may be substantially underreported. And, as in prior years, there are no available data pertaining to the severity of injuries.

Of the fires reported through the National Fire Incident Reporting System, the average loss per fire in 1983 was $3,500. When data for structural fires are studied separately, the mean figure is considerably higher. As in prior years, nearly half of all reported dollar loss occurred in residential property fires.

This edition of *Fire in the United States* marks the first year that the NFIRS data base was of sufficient size to be used as a primary reference source in the calculation of property loss estimates. In past editions, the U.S. Fire Administration has relied upon the projected estimates of other organizations—notably the National Fire Protection Association. Because of this change, a comparison of 1983 property loss estimates to those of prior years is not practicable.

U.S. FIRE PROPERTY LOSS PER CAPITA IN 1983 AND ACTUAL DOLLARS



Source: National Fire Protection Association
Population—U.S. Census Bureau
Inflation Factor—Consumer Price Index, U.S. Bureau of Labor Statistics

Note: Top bar reflects dollars adjusted for inflation (1983 dollars).

Figure 2.4

NEW AND POTENTIAL FIRE PROBLEMS

One of the principal functions of the U.S. Fire Administration is to research problems that could exacerbate the existing and future condition of the nation's fire problem. In 1983, the following subjects have been identified as areas warranting special attention and concern.

NEW PROBLEMS

Boarding, Rooming, and Half-Way Houses. Short-term lodging provided through boarding, rooming, and half-way facilities has resulted in a particularly critical element of the fire problem in recent years. The risk of death from these fires is 27 per 1,000 fires compared to 7.2 per 1,000 fires in other residential categories. From the standpoint of fire prevention and safety, these structures often are inadequately designed and maintained.

Alternative Heaters Used As Primary Heat Sources. Analysis of NFIRS records indicates that alternative heating is becoming a major fire problem. Solid fuel heating equipment is the largest single source of fires in one-and-two family homes. Fortunately, these fires seldom cause death or large dollar loss. At present, they do however, require a significant commitment of fire safety and fire prevention resources.

Portable local heaters (space heaters) cause relatively few reported fires. However, these fires show an inordinately high risk of death—the risk of death in a space heater fire is about ten times the national average, and about six times that of the average residential fire. What is worse, the risk appears to be increasing—a 50 percent increase from 1982 to 1983.

Auxiliary Fuel Tanks. In the aftermath of the gasoline crisis of 1973, many drivers remained concerned about running out of fuel. Initially, motorists responded to these apprehensions by placing a five gallon gas can in their trunks. It was an obviously dangerous practice, often deadly in the event of a rear-end collision. Later, many motorists—particularly van and pick-up truck drivers—began placing auxiliary tanks in their vehicles. Some such vehicles were involved in fires in 1983. There are insufficient data to determine the scale of this problem; nonetheless, it is an area of concern that bears watching.

Residential Fire Deaths Smoke and Fire Detectors Present. The U.S. Fire Administration has been promoting the routine use of smoke and fire detectors as an aid to fire safety since the Agency's inception in 1978. The capabilities of these devices to reduce the severity of fire losses have substantial documentation. Nonetheless, in recent years a surprisingly large number of residential fire deaths have occurred where a detector was present in the structure.

While analysts currently do not have sufficient evidence to determine why this is so, it is probable that several factors are involved. In some instances, victims may have been too young, too old, or too incapacitated to have saved themselves. In turn, some individuals may have failed to awaken at the sound of the detector's alarm. A few victims may have remained in a structure in a futile attempt to control the fire. And, some victims, having successfully fled the building once, may have returned to the structure but were unable to escape a second time.

Clearly, it is essential that individuals routinely check their detectors to ascertain that they are functioning properly. It is also evident that people should not become overly

reliant on the protection afforded by their smoke and fire detection units. A smoke alarm should never replace an individual's complete plan for fire safety.

POTENTIAL PROBLEMS

Envelope Houses. Designed and constructed for energy efficiency, these houses are positioned partially underground. They are ultra-tight, super-insulated units. Preliminary evidence suggests that when fires occur in envelope houses, losses can be particularly severe. Little heat can escape and, hence, fires become very intense.

Glued-Wood Trusses. In recent years, glued-wood trusses are commonly used in new construction in place of wooden or metal supports. These trusses—composed of small pieces of wood which are glued together between two or more larger pieces—are used as a means of reducing costs of construction. Under normal circumstances, glued-wood trusses are an acceptable alternative to traditional types of support. Preliminary findings suggest that the new trusses may pose a hazard during fires. During the high temperatures common to so many structural fires, it appears that the glue used in the trusses can melt, or one small member may burn through. In such instances, a structure is prone to collapse—thereby creating a dangerous setting for fire fighters.

Cabinet Heaters. A central issue of concern to the fire service is the potential use of cabinet heaters in the United States. These portable heaters—which have long been available in Europe—house a 20 pound rechargeable propane cylinder (Europeans use butane instead). The domestic gas industry has expressed strong interest in marketing the heaters in the U.S. as a means of competing with the kerosene heater industry.

Cabinet heaters pose several severe hazards in terms of fire safety. Perhaps of foremost concern, cabinet heaters present a serious safety risk when overfilled. If a unit is filled in a cold outdoor storage area and brought into a warm structure, the resultant excess pressurization could trigger the relief valve thereby releasing an abundance of LP gas into the user's home. In addition, the unit's relief valve could be triggered when the unit is heated by a fire on a lower floor. Assuming the escaping gas reaches the fire, an ignition would result. Analysts are also concerned about faulty connections and the potential hook-up of 40-pound cartridges, used for gas barbecues.

The gas industry maintains that cabinet heaters can be used safely by consumers. However, fire analysts have expressed strong concerns.

ABOUT THE TERMS USED IN THIS SECTION

Accuracy in fire analysis and research requires precise terminology and careful categorization of the data that are collected. The following definitions (based on NFPA Standard 901, 1976 Edition) show the basis of the terms as used throughout this section:

Fires - Hostile, destructive, and uncontrolled combustion, including explosions, that are reported to public fire departments.

Fire Deaths - Deaths directly or indirectly caused by fire. Directly caused fire deaths include those by burns, asphyxiation, or fatal injuries sustained by fire fighters performing fire duty. Fatal injuries indirectly resulting from fire include cuts by broken glass, falls while fighting a fire, and falls while attempting escape or rescue. Death from a subsequent infection that resulted from an injury is an example of an indirectly caused fire death. To be classified as a fire death, the death must occur within one year of the fire.

Fire Injuries - Physical damage to a person that requires (or should require) treatment by a practitioner of medicine (whether or not the treatment was actually received) or that results in a minimum of one day of restricted movement after the incident.

Direct Property Loss - Total financial loss to property, including contents, machinery, stock and equipment, and physical structure. Direct property loss is determined by an estimation of the cost of replacement of like kind and quality.

Indirect Loss - Costs indirectly caused by fire including salvage costs, loss of profits or wages, medical treatment, funeral expenses, added living expenses (such as living in a hotel, eating in a restaurant, or renting temporary quarters.)

chapter 3

the fire problem: an overview

THE FIRE PROBLEM: AN OVERVIEW OF 1983

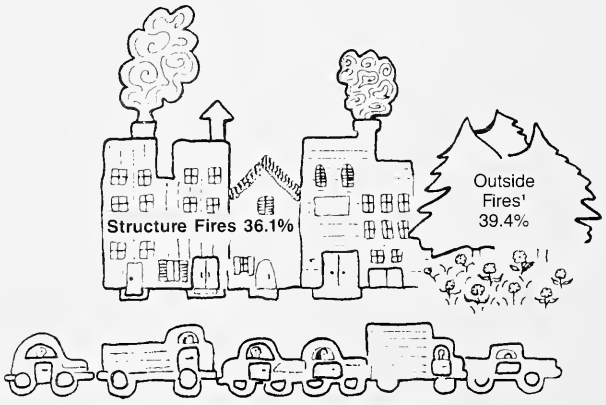
FIRES

THE PROBLEM

The devastation wrought by fires presents a critical problem for the nation. Death, injury, emotional and financial loss are the sad residue emitted from the embers of these fires. Thousands of Americans suffer from their effects. And, while accomplishments in fire prevention have been made, the incidence of fire remains far too frequent. In 1983 alone, the U.S. Fire Administration estimates approximately 2.4 million fires occurred.[6] This translates to an average of more than 6,800 fires daily. In addition to these, a substantial number of unreported fires occur each year. Some authorities place the number of unreported fires in residences as high as 90 percent. The U.S. Fire Administration is continuing its mission to reduce these numbers by determining the nature and location of fire problem areas and by outlining and implementing intervention strategies for improvement.

This section explores the nation's fire experience in 1983 as reported through the National Fire Incident Reporting System (NFIRS) of the U.S. Fire Administration and other sources.

WHAT KINDS OF FIRES OCCUR



[1] This category includes the following classifications: outside of structure fires; tree, grass, and brush fires; refuse fires; fires involving oil spills and leaks; explosions; and other miscellaneous fires.

Source: NFIRS Data, 1983
U.S. Fire Administration

Figure 3.1

[6]The National Fire Protection Association, in their annual study "Fire Loss in the United States During 1983" (*Fire Journal*, September 1984, p. 48 et seq.), estimated 2,326,500 such fires. To these must be added some 170,000 fires reported to the U.S. Forest Service Bureau of Cooperative Forest Fire Control.

WHAT IS BURNING

To understand the nature of the fire activity in 1983, it is important to first examine what types of fires took place in the nation. Figure 3.1 categorizes the fires that occurred.

Fires most frequently occur in outdoor areas. In 1983, according to NFIRS data, 39.4 percent of the fires reported fell in this category. Of these, 19.9 percent took place in trees, brush, or grasslands; 15.4 percent occurred in trash and refuse areas; and 4.0 percent took place in other outside areas of value.

Structural fires are second ranking in terms of numbers but pose the most serious threat to public safety. In 1983, NFIRS data indicates that 36.1 percent of the fires that occurred were in structures. A specific breakdown of fires by property use is presented in the following tables.[7]

FIRE PROBLEMS BY FIXED PROPERTY USE USING ABSOLUTE MEASURES

Category of Fixed Property Use	Reported Fires	Deaths	Injuries	Direct Property Loss (Millions)
Public Assembly Property	14,718	17	824	$ 172.0
Educational Property	6,613	1	176	$ 26.0
Institutional Property	6,914	15	401	$ 10.0
Residential Property	233,541	1,679	16,313	$1,254.0
Store/Office Property	22,080	30	1,247	$ 226.0
Basic Industry Property	14,974	15	285	$ 109.0
Manufacturing Property	10,785	31	1,044	$ 235.0
Storage Property	27,111	32	1,444	$ 253.0
Special Property	358,320	441	3,285	$ 316.0
Unclassified	32,191	36	425	$ 50.0
Invalid or Blank	33,692	15	261	$ 13.0
Column Totals	760,939	2,312	25,705	$2,665.2

Table 3.1

Source: NFIRS Data, 1983
U.S. Fire Administration

[7]For those readers who are unfamiliar with absolute and relative measurements, the introduction of this report contains a helpful overview on these methods of analysis.

FIRE PROBLEMS BY FIXED PROPERTY USE USING RELATIVE MEASURES

Category of Fixed Property Use	Reported Fires	Deaths Per 1,000 Fires	Injuries Per 1,000 Fires	Direct Property Loss Per Fire
Public Assembly Property	14,718	1.2	56.0	$11,700
Education Property	6,613	0.2	27.0	4,000
Institutional Property	6,914	2.2	58.0	1,400
Residential Property	233,541	7.2	70.0	5,400
Store/Office Property	22,080	1.4	56.5	10,200
Basic Industry Property	14,974	1.0	19.0	7,300
Manufacturing Property	10,785	2.9	96.9	22,000
Storage Property	29,111	1.2	33.0	9,300
Special Property	358,320	1.2	9.1	900
Unclassified	32,191	1.1	13.0	$ 1,600
Invalid or Blank	33,692	0.4		
Column Totals and Averages	760,939	3.0	34.0	$ 400

Source: NFIRS Data, 1983
U.S. Fire Administration

Table 3.2

Where fires occur by fixed property use is further illustrated in the following figure.

WHERE FIRES OCCUR, BY FIXED PROPERTY USE

Residential 30.7% | Special Property 47.1% | Manufacturing 0.4% | Basic Industry 2.0% | Stores/ Office 2.9% | Public Assembly 1.9% | Institutions 0.9% | Storage 3.6% | Educational 0.9%

Note: In 8.6% of the incidents reported by NFIRS respondents, fixed property use categories were unclassified or blank.

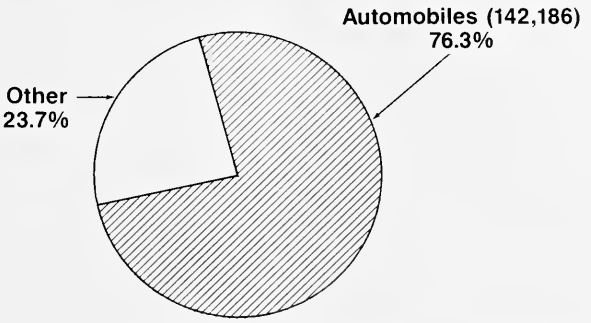
Based on 760,939 Fires

Source: NFIRS Data, 1983
U.S. Fire Administration

Figure 3.2

Of the 760,939 incidents reported in NFIRS in 1983, nearly one-fourth (24.4 percent) were mobile property fires. Of these, the vast majority (76.3 percent) were automobiles.

WHERE FIRES OCCUR IN MOBILE PROPERTY



Source: NFIRS Data, 1983
U.S. Fire Administration

Figure 3.3

WHEN FIRES OCCUR

Fires typically increase in number through the months of June, July, and August. This pattern arises from the large number of fires that occur in grasslands, forests, and other outdoor areas during the summer months.

In partial jest, one fire authority once observed that men, women, and children are the three leading causes of fire. In fact, NFIRS data supports this view. In the summer months, when a large number of people are out of doors, outside fires are prevalent. In turn, structural fires peak in the winter months when people spend more time indoors. Clearly, human involvement is a striking contributor to this pattern.

Other elements also are factors, however. For example, the relatively low humidity of heated air in homes seems to have a role in the prevalence of winter structural fires.

The highest incidence of fires typically occurs on Saturday. Generally, fires rise toward a peak on Saturday and decline again toward the middle of the week.

By hour, fires crest in number in the late afternoon and early evening between about 3:00 and 6:00 p.m. According to analysts, this pattern seems to be attributable to two factors: juvenile fire setters who are left unsupervised after school and cooking-related fires as people prepare their evening meals.

WHERE FIRES START

About 64 percent of all fires start outside of buildings and most remain there. When fires begin inside a structure, it is the "function areas," e.g., kitchens, bedrooms, and cloakrooms, which are the most likely locations of ignition. Lounge areas (living rooms and dens), egress (entrances and exits), and trash areas are also common locations for

fires. Residential fires so dominate the overall fire problem that the top areas of origin are those within residences.

WHERE FIRES START

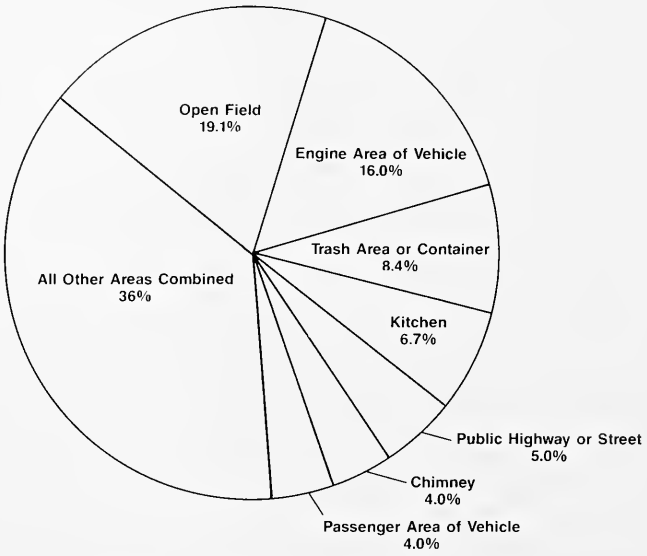


Figure 3.4

Source: NFIRS Data, 1983
U.S. Fire Administration

HOW FIRES START

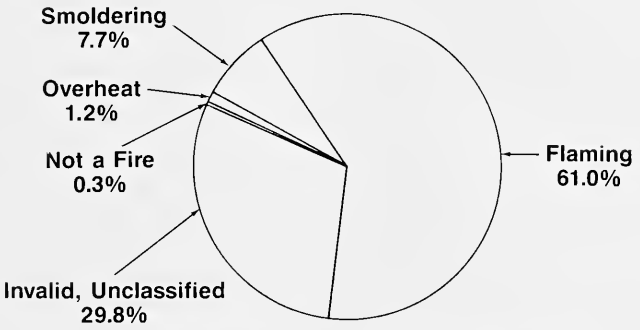
More than half of the nation's fires begin through equipment-related problems. In 1983, NFIRS data indicated that the leading contributors of equipment-related fires were heating systems, cooking equipment, and electrical distribution equipment.

In close to half of the fires reported in 1983, no equipment was involved. One-fourth of these fires were caused by cutting and welding torches, open flames, matches, lighters and candles.

Humans, through either carelessness, lack of knowledge, or malevolence, clearly have a substantial role in fire ignition. However, it is difficult to gauge the number of fires that are started due to human involvement. Analysts of 1983 NFIRS data estimate that 17.2 percent of the fires appear to have been set intentionally. These same analysts concede that there probably were many more set than were recognized as such. About the same proportion of fires—16.4 percent—were of unknown origin.

Any examination of fire incidence is limited unless we also review termination patterns. Figure 3.5 provides a breakdown of this information, indicating close to two-thirds of all fires (61.0 percent) are terminated in the "flaming" stage.

TERMINATION STAGE OF FIRES



Source: NFIRS Data, 1983
U.S. Fire Administration

Figure 3.5

MEASURING THE RISK OF FIRE DEATH

Fire fatalities are typically measured in three ways, each providing a different perspective on the fire fatality problem. The first method of measurement is in *absolute numbers*—that is, the actual number of the fire fatalities occurring in a given state. This particular form of measurement provides information about the *scope* of the problem, detailing the exact number of deaths by state and across the nation. Using this method, analysts find that the larger states tend to have the highest number of fire fatalities.

The second measurement used in reporting fire fatalities is deaths per million population. This measurement provides information regarding the personal risk faced by people in a given state or county. The deaths per million measurement enables analysts to compare the *relative* risk of becoming a fire death in large and small states.

The third form of measurement commonly used to review fire fatalities is the number of deaths per 1,000 fires. This technique provides invaluable information regarding the effectiveness of fire prevention and public education measures. For example, consider a state which finds that a significant *decrease* has occurred in the *number* of fires statewide, but that deaths from these fires are actually *increasing*. On a superficial level, the fire problem appears to be improving. However, reviewing the data from a different angle enables analysts to see that while the number of fires is decreasing, the number of deaths is actually increasing. State authorities can use this information to develop prevention and education strategies specifically targeted to reduce the incidence of fire fatalities.

FIRE FATALITIES

THE PROBLEM

Fire is the fourth largest accidental killer in the United States. Year after year, it brings death to thousands of Americans. In 1983 alone, more than 6,100 people died as the result of fire. The vast majority of these fire fatalities occurred among the civilian population; only 60 deaths were among the nation's fire fighters.[8] It is clear that far too many people die needlessly by fire every year, and the U.S. Fire Administration is dedicated to reversing this deadly phenomenon through fire prevention and public education efforts.

WHERE FIRE DEATHS OCCUR

By Country. Fire death rates vary considerably from country to country. However, among industrialized nations, the United States has one of the highest fire death rates in the world. Fire analysts differ about why this is so. What is clearly evident is that insufficient international research has been conducted to provide adequate answers to this discouraging U.S. trend. In 1983, the United States ranked third.

Figure 3.6 indicates, in rank order, by country, fire death rates among developed nations.

FIRE DEATHS IN DEVELOPED NATIONS PER MILLION POPULATION

Fire Deaths Per Million Persons Per Year

Scotland	32	France, England, Wales	14
Canada	31	Sweden	14
United States	27	Japan	13
Ireland	24	Australia	10
Finland	22	Spain, Germany	9
Portugal	20	Italy	7
Norway	18	Switzerland	5

Source: United Nations World Health Organization

Figure 3.6

[8] A total of 110 fire fighters died in 1983; however, only 60 of these deaths occurred while actually fighting fires.

By State. Fire fatalities tend to be distributed according to population density. That is, those states with the largest populations tend also to have the greatest number of fire fatalities. Table 3.3 is a display of states ranked by size with the number of fire fatalities occurring in each state in 1983.

FIRE DEATHS IN THE UNITED STATES, BY STATE, USING ABSOLUTE MEASURES[1]

The Following States Account for Close to 50% (3,006) of All Fire Deaths Nationally

- New York (516)
- California (412)
- Illinois (387)
- Texas (358)
- Pennsylvania (313)
- Georgia (243)
- Ohio (225)
- Michigan (188)
- No. Carolina (188)
- Florida (176)

The Next Ten States Account for an Additional 25% (1,420) of All National Fire Deaths

- Tennessee (171)
- So. Carolina (159)
- Louisiana (158)
- Missouri (144)
- Alabama (141)
- Massachusetts (131)
- Virginia (129)
- Maryland (129)
- Mississippi (129)
- New Jersey (129)

The Remaining Thirty States Account for the Remaining 25% (1,228) of National Fire Deaths[2]

- Indiana (126)
- Kentucky (118)
- Oklahoma (82)
- Wisconsin (80)
- Minnesota (73)
- Iowa (69)
- Connecticut (65)
- West Virginia (64)
- Oregon (61)
- Arkansas (44)
- Kansas (40)
- Washington (40)
- Nebraska (29)
- Maine (29)
- Vermont (29)
- Alaska (27)
- Dist. Columbia (25)
- Utah (23)
- Delaware (23)
- N. Dakota (21)
- Montana (19)
- South Dakota (19)
- Arizona (19)
- Nevada (19)
- New Hampshire (18)
- Hawaii (17)
- Rhode Island (17)
- New Mexico (16)
- Idaho (10)
- Wyoming (6)

[1] This list accounts for approximately 93% (5,654) of the estimated 6,100 fire deaths annually.

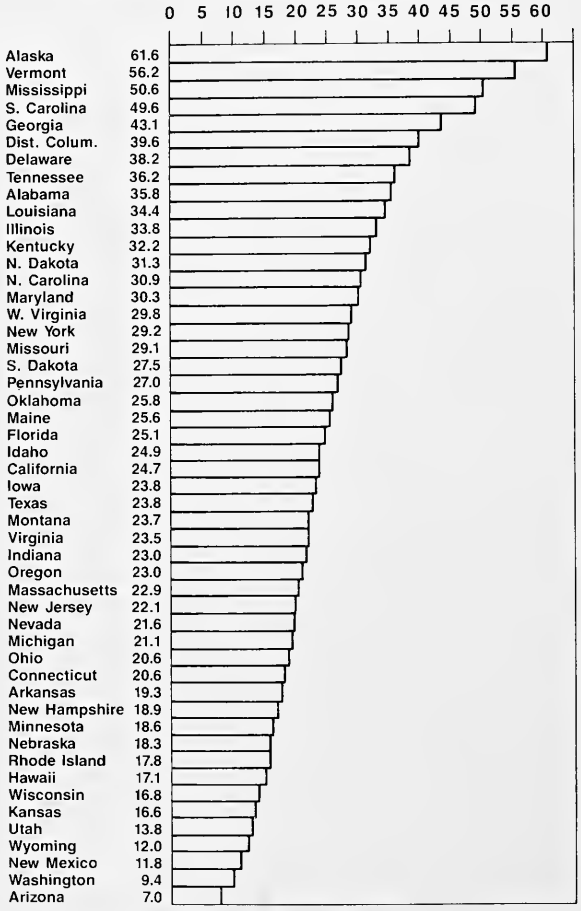
[2] Colorado is excluded from this list because it did not report fire deaths to the U.S. Fire Administration in 1983.

Source: State Fire Marshal's Offices, Dept. of Health, Bureau of Vital Statistics.

Table 3.3

While it is useful to know by state where the greatest number of fire deaths occur, it is perhaps even more useful to know in which states people face the greatest personal risk of death by fire. The per capita fire death rate (usually expressed per one million population) provides the reader with a standardized method of comparing small and large states with regard to fire fatalities. Figure 3.7 indicates those states—in rank order—which have the highest per capita fire-related death rates. As is evident from Figure 3.7, on a per capita basis, Alaska, Vermont, and Mississippi present the highest risk of death by fire in the nation. In turn, the states of New Mexico, Washington, and Arizona have the lowest fire death rates.

DEATH RATES PER MILLION POPULATION, IN RANK ORDER, BY STATE



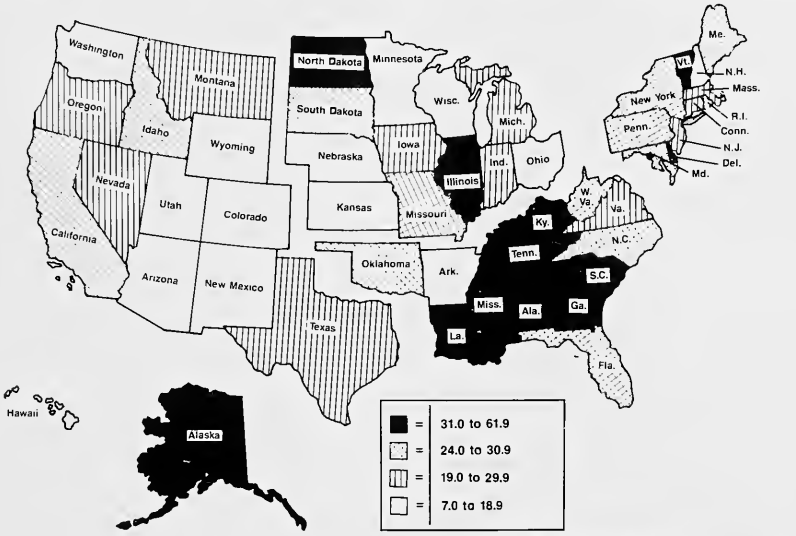
Source: State Fire Marshal Offices,
U.S. Department of Health and Human Services,
Bureau of Vital Statistics

Note: Colorado data unavailable.

Figure 3.7

By Region of the Country. An analysis of U.S. fire deaths by geographic region reveals that the southeast region of the continental United States has the highest fire death rate in the nation. Figures 3.8 below indicates the number of fire incidents and fire deaths occurring by region, per 1,000 population.

FIRE DEATHS PER MILLION POPULATION, BY REGION



Source: State Fire Marshal's Offices, U.S. Dept. of Health and Human Services, Bureau of Vital Statistics

Figure 3.8

WHO IS DYING

Different segments of the population suffer very different rates of fire death. Men are almost twice as likely as women to die in fires. Children under the age of five and elderly persons over 65 years of age are disproportionately represented in fire death rates. As evidenced by Figure 3.9, blacks and Native Americans are much more likely to die by fire than are whites; Asians, in turn, appear to have much lower rates of fire death than does the population in general. Residents of urban and rural areas tend to exhibit much higher death rates than suburban residents, and not surprisingly, fire fighters, as a group, are far more likely to die as a result of fire than are average citizens.

Children. It is particularly sad when a child is the victim of a fatal fire. Children in the United States—especially young children—face an unusually high risk of death by fire. Overall, the U.S. fire death rate per one million population is about 27 deaths per year. Among children under twelve months of age, the rate is 39 per million population. According to the National Center for Health Statistics, for children between the ages of one and four, the rate is 55 deaths per million population—*more than twice the national average.*

Though distributed fairly equally throughout the general population, boys appear to be over-represented in fire death rates. Figure 3.9 below indicates the death rate by age, and by sex.

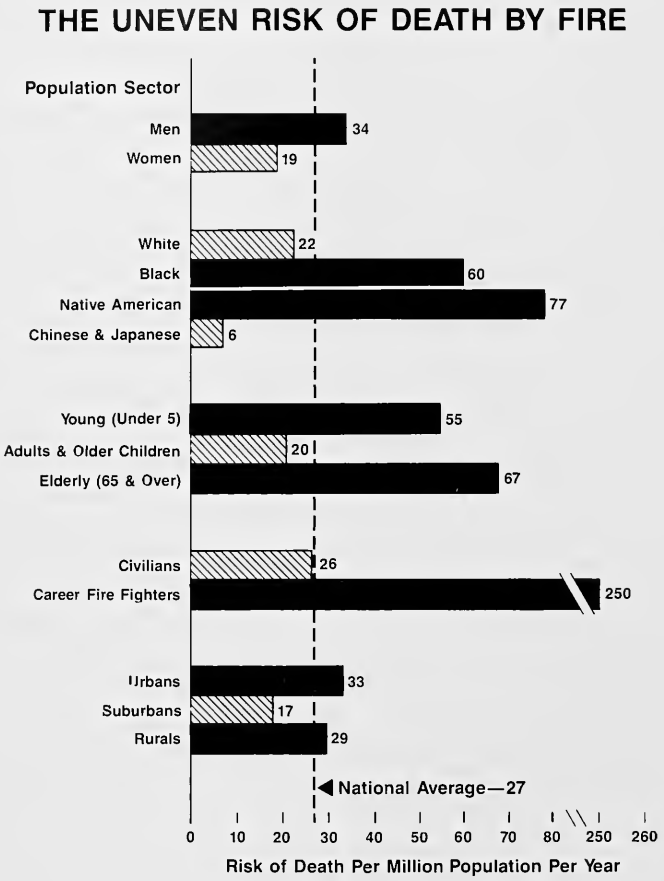


Figure 3.9 Source: U.S. Fire Administration

Some startling facts regarding fire death rates among children have emerged over the past several years:

- Children, particularly those under five years of age, are the most likely victims of multiple fires.
- Non-white children are over-represented in fire death incidence.
- Where fire victims are children, the most common causes of fire are those where children were playing with matches; where persons ignited upholstery by the careless use of cigarettes; and where faulty, or improperly placed, alternative heating devices were used.

- In the past, clothing fires were a major source of fatalities among children. Through the advent of ignition-resistant clothing for children and massive public education efforts, clothing fires among children have decreased by 90 percent over a ten year period.

LOCATION OF CIVILIAN FIRE DEATHS

Approximately three-quarters of all fire fatalities occur in residential dwellings. In other words, the majority of the nation's fatal fires take place in people's homes. While residential fires are discussed in more detail in Section Four of this report, this point warrants special emphasis here.

"Special Property" is the second major property use category where a large number of fire deaths occur. Included in this category is property under construction, under demolition, and vacant units. Also included is outdoor property; e.g., airports, and railways. In addition, this category includes miscellaneous property uses such as telephone booths, bridges, and, hence, includes most transportation fires.

All other property use categories combined have fewer fire deaths than either Residential or Special Property Use alone.[9] This simple statement reveals an important fact. The fire safety record for most property categories has vastly improved over time.

CIVILIAN FIRE DEATHS BY FIXED PROPERTY USE

Use Category		Number of Deaths
Public Assembly		14
Education		1
Institution		15
Residential		1,669
— One & Two Family Dwellings	1,334	
— Apartments	285	
— Rooming & Boarding Houses	18	
— Hotels & Motels	25	
— Dormitories	4	
— Home Hotels	1	
— Other, Unclassified	2	
Store & Office		30
Basic Industry		15
Manufacturing		24
Storage Property		31
Special Property		437
Unclassified		50

Source: NFIRS data, 1983. Based upon 760,939 fires and 2,285 civilian fire deaths collected through the NFIRS system.

Table 3.4

[9]For a complete listing of property use codes, contact the National Fire Protection Association.

In the Public Assembly category, for example, there have been no large disasters involving multiple fire deaths as in the historic fires of the Iroquois Theatre and Coconut Grove Night Club. Further, there were no fire disasters in schools, nursing homes, or jails in 1983.

CIVILIAN FIRE DEATHS BY MOBILE PROPERTY USE

Use Category	Number of Deaths
Passenger Road Vehicle (Includes Car, Bus, Motorcycle, Travel Trailer, Etc.)	313
Freight Road Vehicle	85
Unclassified, Unreported, Other	62
Air Transport	52
Water Transport	6
Rail Transport	1
Heavy Equipment (Includes Earth-Mover, Materials Handling Equipment, Tractor, Harvester, Space Vehicle, Armored Vehicle, Etc.)	1
Total	520

Source: NFIRS data, 1983. Based upon 760,939 fires and 2,285 civilian fire deaths collected through the NFIRS system (excluding mobile home fires).

Table 3.5

WHERE FIRE DEATHS OCCUR BY FIXED PROPERTY USE

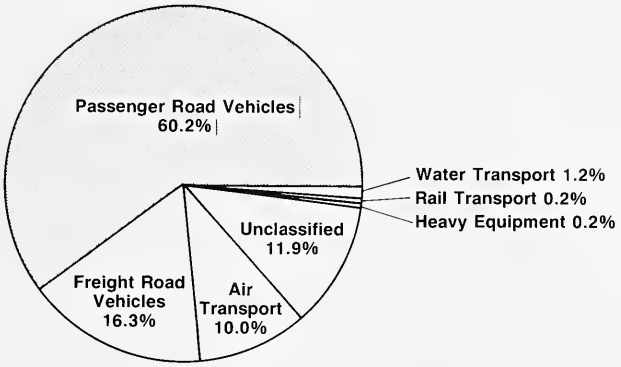
Note: There were no deaths from educational property incidents in 1983.

Source: NFIRS Data, 1983
U.S. Fire Administration

Figure 3.10

About two-thirds (60.2 percent) of the fire fatalities associated with mobile property fires are caused by passenger road transport (motor vehicles), though one does not often think of motor vehicles as being a major contributor to U.S. fire death rates. Motor vehicles, however, are not currently subject to fire safety codes. Consequently, successes attained in building fire safety and concurrent decreases in fire death rates resulting from the implementation of fire codes have had no impact on motor vehicle fire fatalities.

WHERE FIRE DEATHS OCCUR BY MOBILE PROPERTY USE[1]



[1]Excludes Deaths in Mobile Homes

Source: NFIRS Data, 1983

Figure 3.11

WHEN FIRE FATALITIES OCCUR

While most fires tend to occur around mealtime, the vast majority of fire fatalities take place between the hours of midnight and dawn.[10]

Most fatal fires tend to occur on weekends, particularly late Saturday night and early Sunday morning. Deaths resulting from fire are also much more likely to occur during cold winter months—December and January—and are far less likely during summer months. Multiple death fires exhibit the same "clustering," that is, they take place on week-ends, late in the evenings, and during winter months.

[10]Twelve a.m. to 6:00 a.m. are the parameters used in this analysis by the U.S. Fire Administration. However, the parameters differ according to who has done the analysis.

MULTIPLE DEATH FIRES

Multiple death fires are defined as those fires causing three or more deaths. Public fire departments in the United States respond to roughly 2,400,000 fires per year. Of these, about 258 are multiple death fires. While they represent only 0.01 percent of all fires, they constitute 16.1 percent of all fire deaths.

MULTIPLE DEATH FIRES IN THE UNITED STATES USING ABSOLUTE AND RELATIVE MEASURES

	Fires	Deaths	Injuries	$ Loss	Deaths 1,000	Injuries 1,000	$ Loss Fire
Multiple Death Fires[1]	258	983	484	$28 Million	3,810	1,876	$109,000
All U.S. Fires[2]	2,400,000	6,100	110,000	$8.4 Billion	2.5	46	$ 3,500

[1]Multiple Death Study, NFPA
[2]U.S. Fire Administration Estimated Totals

Table 3.6

Multiple death fires are also responsible for a great many injuries and result in tremendous amounts of property loss each year. In 1983, there were 258 fires categorized as multiple death fires: these resulted in 983 deaths, 484 injuries, and an astounding $28 million in property loss.

WHERE MULTIPLE DEATH FIRES OCCUR

WHERE MULTIPLE DEATH FIRES OCCUR, BY FIXED PROPERTY USE

Source: NFPA Data
(Supported Financially by the U.S. Fire Administration)

Figure 3.12

WHERE MULTIPLE DEATH FIRES OCCUR BY RESIDENTIAL CATEGORY

(619) One and Two Family Dwellings: 71.9%

(9) Other: 10%

(54) Rooming, Boarding Houses: 6.3%

(157) Apartments: 18.3%

(21) Hotels, Motels: 25.0%

Source: NFPA Multiple Fire Death Study
Based on 860 Residential Deaths in 258 Multiple Death Fires

Figure 3.13

The National Fire Protection Association (NFPA) studies multiple death fires and publishes the results in its publication *Fire Journal*. According to NFPA, the number of multiple death fires has decreased over the past few years. Nonetheless, these fires continue to be worthy of study because of the large number of fatalities, injuries, and property loss associated with multiple death fires.

Several salient facts emerge from the study of multiple fire deaths.

- Residential fires are the core of the multiple death fire problem as is true of the fire problem in general.
- Approximately half (43 percent) of the residential multiple death fires start in the living room, and roughly one-fourth (22.2 percent) begin in the bedroom.
- Roughly 60 percent of the multiple death residential fires occur between midnight and 8:00 a.m.—the hours normally used for sleeping.[11]
- Victims of multiple death fires are likely to be the very young. The risk of death in a multiple death fire for children under five years of age is close to four times that of the general population. Children between the ages of five and nine are twice as likely to die in a multiple death fire than the general population.
- Multiple death fires involving alternative heating equipment are increasing.[12]

[11]The National Fire Protection Association uses a parameter of 12:00 a.m. to 8:00 a.m. for analysis, while the U.S. Fire Administration examines fire occurrence in four time blocks, thereby using the periods between 12:00 a.m. to 6:00 a.m., to designate night.

[12]The Special Topics Section provides a comprehensive treatment of this problem.

- Multiple death fires of incendiary origin (arson) appear be decreasing overall despite disproportionately high rates in the southern and northeastern regions of the nation.

- The elderly face a much greater risk of death in multiple death fires than does the general population.

- Multiple death fires in the western region of the United States are relatively rare.

- Catastrophic fires, those causing ten or more deaths, have decreased in recent years. There were only two such fires in 1983: a fire aboard an airplane killed 23 people and a pipeline explosion killed eleven.

- No single fire in 1983 caused deaths of 100 or more.

- Multiple death fires exhibit the same clustering as other fatal fires, that is, they tend to occur on week-ends, late in the evening, and during the cold winter months.

- Factors which influence the spread of the fire; e.g., combustible interior finish and inadequate fire and smoke cut-offs, play a more significant role in multiple death fires than in fires causing one or two fatalities.

The NFPA also found that, with the exception of the residential settings prevalent in multiple death fires, conditions which accompany multiple death fires are extremely similar to those which accompany large loss fires.

FIRE INJURIES

THE PROBLEM

One of the saddest aspects of the fire problem is found in its injured victims. Each year, thousands of Americans begin the long and painful road to recovery from burn injuries—a goal complicated for many by the psychological burden of physical disfigurement. For others, who have escaped burns, it is the after-effects of asphyxiation or other fire-related injuries that must be endured. While progress has been made in the reduction of injuries over the past ten years, much needs to be accomplished in this area.

HOW INJURY ESTIMATES ARE DERIVED

Unfortunately there is no agreement as to the number of fire injuries occurring in the United States each year. The National Fire Protection Association (NFPA) estimates that there were approximately 91,000 injuries, 63,000 of which occurred among fire fighters in 1983. In turn, the National Electronic Injury Surveillance System (NEISS), which is run by the Consumer Product Safety Commission, estimates about 41,000 civilian fire injuries occur annually.

In 1983, the National Fire Incident Reporting System (NFIRS) reported 12,576 fire fighter injuries and 13,129 civilian injuries. Analysts in the U.S. Fire Administration feel that these reported figures may be considerably lower than the actual numbers. They point to several limitations in the data collection process. As we have noted previously in this report, not all fire departments report to NFIRS. Of the some 28,000 public fire departments in the United States, about 10,000 participate in the NFIRS system. While NFIRS maintains a relatively high percentage of participation, reporting among these departments remains somewhat uneven. Some participating departments neglect to report every fire or every casualty.

Other factors also may cause some distortion of injury data. For example, it is believed that fire fighters tend to report injuries to fire fighters more completely than injuries to civilians. Civilian injuries also seem to be incompletely reported where a fire department does not provide Emergency Medical Services (EMS). Some civilian injuries may not come to the attention of the fire department at all. A family member, neighbor, or passerby may rush an injured party directly to a hospital; in such an instance, the resulting injury will never be reported to a fire service agency.

In recent years, several local jurisdictions have set up burn injury registers with mandatory reporting requirements (as is currently required for gun shot wounds). The U.S. Fire Administration supports these efforts and hopes these registers will produce reliable counts of fire injuries to complement that provided by NFIRS. Burn injury registers are operating in Massachusetts and parts of New York State; Texas and North Carolina are expected to begin operation in the near future.

Using data provided by NFIRS, NEISS, NFPA, and other sources, a brief analysis of civilian fire injuries follows. Information on fire fighter injuries can be found in Section Five of this report.

In fixed properties, most injuries occur in residential and special properties. Table 3.7 provides information about the distribution of injuries by fixed property use.

WHERE CIVILIAN FIRE INJURIES OCCUR BY FIXED PROPERTY USE

Property Use Category	Number of Fires	Civilian Injuries	Injuries Per 1,000 Fires
Public Assembly	14,718	234	15
Educational	6,613	95	14
Institutional	6,914	315	45
Residential	233,541	8,930	38
Store/Office	22,080	434	19
Basic Industry	14,974	121	8
Manufacturing	10,785	437	40
Storage	27,111	441	16
Special	358,320	1,719	4
Other, Unclassified	65,883	403	6
Total	760,939	13,129	17

Source: NFIRS Data, 1983
U.S. Fire Administration

Table 3.7

An overview of the distribution of injuries in mobile property categories is provided in Table 3.8.

WHERE CIVILIAN FIRE INJURIES OCCUR, BY MOBILE PROPERTY TYPE

Mobile Property Type	Fires	Civilian Injuries	Injuries/ 1,000 Fires
Passenger Road Transport[1]	146,420	1,168	7.0
Freight Road Transport	23,334	331	14.0
Rail Transport	1.003	3	2.0
Water Transport	1.420	140	98.0
Air Transport	224	14	62.0
Heavy Equipment	3,373	67	19.0
Special Vehicles[2]	22,698	41	1.0
Other	3,227	57	17.0
Total	201,699	1,821	9.0

[1]Includes unclassified, passenger road transport, buses, terrain vehicles, and other similar mobile property types. This category does *not* include motor or mobile homes.

[2]Includes mechanically-moved trash containers.

Source: NFIRS Data, 1983
U.S. Fire Administration

Table 3.8

Most civilian fire injuries occur in structure fires (10,374 injuries) and motor vehicle fires (1,694 injuries). In terms of sheer numbers, it is the structure fire that warrants the most concern. And, as in most other measures of the fire problem, fires in residential structures are the major source of the fire injury problem.

WHERE CIVILIAN FIRE INJURIES OCCUR BY TYPE OF SITUATION FOUND

Type of Fire	No. of Fires	No. of Civilian Injuries	Injuries Per 1,000 Fires
Structure	275,068	10,374	38.0
Vehicle	186,112	1,694	9.1
Outside	292,443	1,038	3.5
Other & Unclassified	7,316	211	4.0
Total & Average	760,939	13,129	17.0

Table 3.9

Source: NFIRS Data, 1983
U.S. Fire Administration

Single factor analysis provides valuable insights about why this pattern occurs.

SINGLE FACTOR ANALYSIS OF CIVILIAN INJURY-PRODUCING FIRES

Area of Origin

	Number of Injuries
Kitchen	2,624
Bedroom	2,233
Living Room, Lounge, Den	1,663
Vehicle Area	1,628

Equipment Involved

	Number of Injuries
No Equipment	4,646
Cooking Equipment	2,030
Vehicle	701

Form of Heat of Ignition

	Number of Injuries
Match, Lighter	1,618
Gas Fuel Equipment	1,535
Cigarette	1,384
Properly Operating Electrical Equipment	1,162

Type of Material Ignited

	Number of Injuries
Textiles: Cotton, Silk, Rayon, Etc.	2,680
Gasoline	1,825
Grease (Food)	1,129
Sawed Wood	746

Form of Material

	Number of Injuries
Bedding, Mattress, etc.	1,428
Cooking Materials	1,338
Upholstery	1,099
Electrical Wiring	499
Clothing	479
Trash	401

Ignition Factor

	Number of Injuries
Incendiary, Suspicious	1,225
Unattended, Inattentive Operation	874
Child Playing	853
Part Failure	592
Short Circuit, Fault	642

Table 3.10

Source: NFIRS Data, 1983
U.S. Fire Administration

Scenario analysis enables analysts to examine the chain of events that cause fire injuries to occur. Table 3.11 lists injury causing fire scenarios.

TOP SCENARIOS IN INJURY-PRODUCING FIRES[1]

Property Use Category	Time of Day	Heat of Ignition	Material Ignited
Residential	Night	Smoking Materials	Upholstery
Residential	Night	Smoking Materials	Bedding
Residential	Day	Match or Lighter	Bedding
Residential	Night	Electric Wiring	Structural Framework
Residential	Night	Match or Lighter	Bedding
Residential	Day	Cookstove	Grease (Food), Cooking Oil

[1]The scenario list is not intended to be inclusive—rather, it lists the most frequent scenarios.

Source: NFIRS Data, 1983
U.S. Fire Administration

Table 3.11

As both the single factor analysis (Table 3.10) and the scenario analysis (Table 3.11) indicate, fires that cause injury are quite similar to those that cause death. Ignition of upholstery or bedding by smoking materials and the ignition of the residential structure by electric wiring are key factors in the top fire injury scenarios.

One significant difference between fatal fires and fires causing injury is the degree to which cook stoves are involved. While not a major source of fire *fatalities*, they figure highly in fire *injuries*.

WHAT ARE THE IMPACTS OF FIRE INJURY

The primary types of fire injury are burns and asphyxiation—occurring either singly or in combination with other injuries. Other types of injury are relatively rare among both civilians and fire fighters. Unfortunately both burns and asphyxiation are extremely painful and complex to treat. Sadly, the experience of one burn victim is not uncommon; she required thirteen skin graft operations during her six month hospitalization.

In addition to the intense pain and intricacy of treatments, fire injuries incur tremendous costs. Burn care is quite expensive. The cost of treating the victim mentioned earlier exceeded $500,000, and she remains physically impaired as a result of her injuries.

Beyond the physical injury sustained in a fire, there is also extensive psychological injury. The woman requiring the thirteen skin grafts also required two years of psychotherapy after her initial six month hospitalization. In a recent study of residential fires conducted by the U.S. Fire Administration, data indicate that one out of every nine injured civilians sought counseling for emotional problems experienced as a result of the fire. It is quite probable that an even greater number of victims should seek counseling but never do.

In recent years, specialized burn treatment centers have come into existence and have achieved notable success in the treatment of fire-injured victims. Perhaps of greatest importance, these burn treatment centers enable a sterile environment to be maintained. In addition, specially developed, high protein, liquid diets are designed and a host of other finely tailored services are provided to burn patients at these centers. While the costs of care associated with these centers are naturally very high, the efficacy of the treatment that they provide mark a substantial milepost in this troubling segment of the fire problem.

PROPERTY LOSS

THE PROBLEM

The meaning of property loss is vividly demonstrated to anyone who has stared among the ruins of a destructive fire. Each year, thousands of fire victims pick up the charred pieces of their respective losses and initiate the laborious process of calculating the extent of damage that has occurred. Precious heirlooms and keepsakes, valuable equipment and stock, the interruption of day-to-day business are but some examples of the costs that must be factored into a victim's losses. The national figures of estimated losses are staggering. In 1983, the U.S. Fire Administration estimated that $8.4 billion in direct property losses had occurred from the nation's fires. Table 3.12 shows how this loss was distributed.

1983 PROPERTY LOSS ACTIVITY

Type of Fire	Reported Incidents	Total Estimated Loss	Average Loss
Structure Fires	275,068	$2,284,800,000	$8,300
Mobile Property Fires	186,112	$ 311,000,000	$1,700
Outside Fires	299,759	$ 69,700,201	$ 200
Total	760,939	$2,665,200,000	$3,500

Table 3.12

Source: NFIRS Data, 1983
U.S. Fire Administration

Unfortunately, calculating an estimate of loss is not a simple process. For those readers who are unfamiliar with the methods of property loss appraisal, a brief overview follows.

Monetary loss is one of the basic measures of fire severity. However, it is also the least complete and least precise of the four absolute measures used in this report. The difficulty in measurement stems from the cloudy nature of loss: while the fact that fire damage has taken place may be obvious, the amount of loss that has occurred is not always clear.

To illustrate the complexity of making loss estimates, consider the experience of one local fire chief. His department extinguished a porch fire at a residence in an affluent section of town. Although some smoke filtered into the house, damage was perceived to be minimal. The next morning an insurance investigator contacted the chief's office for information concerning, what he described, as a "major-loss" fire. As it happened, the residence housed a famous painting by Modigliani. To the chief, assuming he had even seen the painting, it was just a picture on the wall. His estimate of the total loss was $20,000; in fact, damage to the painting alone was over $140,000.

It is incidents such as these, and other factors, that make fire loss estimates difficult to obtain. Some fire departments do not report losses at all. Others are reluctant to attempt a precise monetary estimate and, instead, categorize loss as small, medium, or large. While a relatively high number of the incidents reported to NFIRS include dollar estimates, little is known of their accuracy and precision. Although, the means for collecting property loss data remains imperfect, these estimates still provide valuable information regarding this aspect of the fire problem.

The damage that occurs from fire may be divided into two categories: direct property loss and indirect loss. Direct loss refers to property value that has been destroyed or diminished by fire. Indirect loss refers to less tangible costs incurred by fire. It includes such examples as the loss of wages to employees of the site where the fire occurred and the costs of having to find temporary shelter. Calculating the nature of indirect loss is a particularly complex process. This report *only* addresses *direct property loss*.

There are several methods for calculating direct loss. In the National Fire Incident Reporting System (NFIRS), a method known as the *sale value* approach is used. In sale value appraisal, the cost of purchasing a replacement of like kind and quality is determined. The approach is not without limitations. Suppose that, in the course of a fire, a dish from a rare set of china is broken. Is the cost of replacement, then, the cost of the single dish or the cost of a new set of dishes? As another example, consider the destruction by fire of a small town's only school. How can an accurate cost of replacement be determined? In both of these instances, there may be no suitable replacement available. Despite these deficiencies, in most instances, the sale value method is a sound approach.

ABOUT DATA SOURCES FOR PROPERTY LOSS ESTIMATES

As we have discussed, estimating the amount of fire-related property loss in the nation is an imprecise process. Sufficient data are not currently available to make a refined estimate. Despite these limitations, several estimates of 1983 data were prepared. The following section briefly examines these figures:

NFPA-Based Estimate - $6,600,000,000

This estimate, derived by the National Fire Protection Association, is based on a survey of 2,600 fire departments in all states and population ranges. The NFPA

estimate may be low due to unreported losses (not all fire departments assign dollar values to losses in their reports) and unknown losses (where the value is not known to the fire service at the time that the report is filed).

Insurance-Based Estimate - $5,800,000,000

This estimate from the Insurance Information Institute includes allowances for unreported losses, uninsured losses, late-reported losses, and underreported losses. However, this estimate does not include property that is not normally insured; e.g., public property, motor vehicles, aircraft, ships, railroads, wildlands, and crops. Between 10 and 20 percent of fire losses occur in these categories.

NFIRS-Based Estimate - $8,400,000,000

As we have previously discussed, NFIRS data is collected on a per incident basis and is submitted voluntarily by participating fire departments. Because of this, NFIRS makes no projections regarding the total number of fires occurring throughout the nation. Hence, there is no precise means of using NFIRS data to calculate the total amount of direct property loss.

An estimate can be determined, however, by calculating the average loss per fire as reported in NFIRS data and by multiplying this figure by the NFPA's estimate of the number of fires. Of the 760,939 fires reported in NFIRS, total direct property losses were reported to be $2,665,232,714, or an average of roughly $3,500 per fire. Hence, the following estimate of total direct loss can be derived:

2,400,000 fires X $3,500 loss per fire = $8,400,000,000 loss

As with the other NFPA and insurance-based figures, the NFIRS loss estimate has several limitations. As in the NFPA survey, loss data in NFIRS is difficult to obtain and may be imprecise. The most notable problem in reviewing NFIRS data undoubtedly is the error of underreporting in property loss. It is anticipated that in future years, loss reporting will be more precise.[13]

WHERE DOES PROPERTY LOSS OCCUR

Of the fires reported through the National Fire Incident Reporting System, the average loss per fire for 1983 was roughly $3,500. However, when data for structural fires are studied separately, the mean figure is considerably higher—$8,000 per fire. As with most other aspects of the fire problem, dollar loss is centered in structural fires. Nearly

[13]While fire fighters are not trained in appraising property loss, their expertise in fire damage and their on-the-scene insights make their financial estimates of property loss very valuable to analysts. The U.S. Fire Administration would like to encourage fire fighters—both in and out of the NFIRS system—to report estimated fire losses. Fire analysts believe that it is only through increased reporting that a more accurate gauge of national trends in property loss can be developed.

half of all reported dollar loss occurred in residential property. Figure 3.14 illustrates the distribution of losses by fixed property use.

WHERE FIXED PROPERTY LOSSES OCCUR

Source: NFIRS Data, 1983
U.S. Fire Administration

Figure 3.14

Based on 760,939 Fires

Average loss in mobile property fires was substantially less than that of structural fires. In 1983, the average loss for mobile property fires was $1,600 as reported through NFIRS.

WHERE MOBILE PROPERTY LOSSES OCCUR

Mobile Property Use	Total Estimated Loss	Percent of Total Loss
Passenger Road Vehicle Property	$195.0	51.8
Freight Road Vehicle Property	$ 67.4	17.9
Rail Transport Property	$ 10.9	2.9
Water Transport Property	$ 17.8	4.7
Air Transport Property	$ 7.9	2.1
Heavy Equipment Special	$ 83.8	20.6
	$382.7	100.0

Note: Totals have been rounded to the nearest $100,000.

Based on 186,112 mobile property fires, NFIRS Data, 1983.

Of the fires reported in 1983, most (29.6 percent) resulted in no loss. In 21.3 percent of the fires, losses between $100 and $999 were reported. In 13.9 percent, losses were estimated to have fallen between $1,000 and less than $10,000. Figure 3.16 further details the manner in.which property loss was distributed.

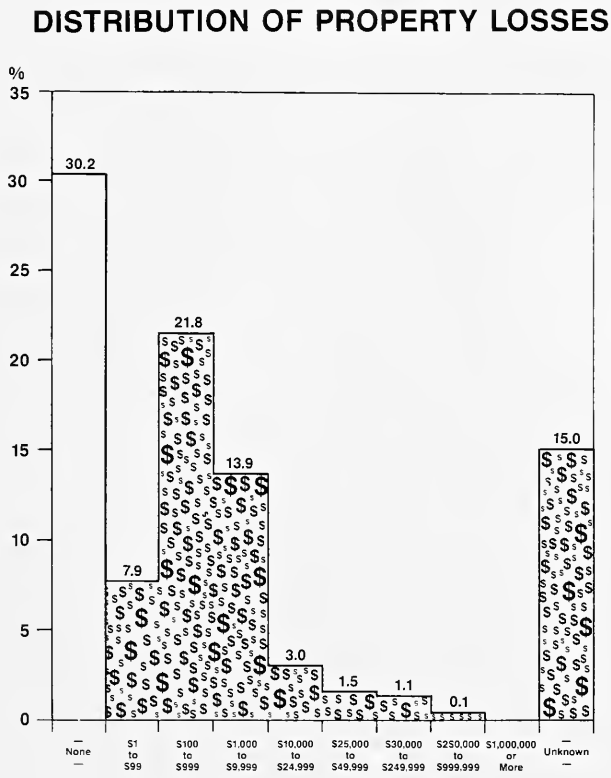
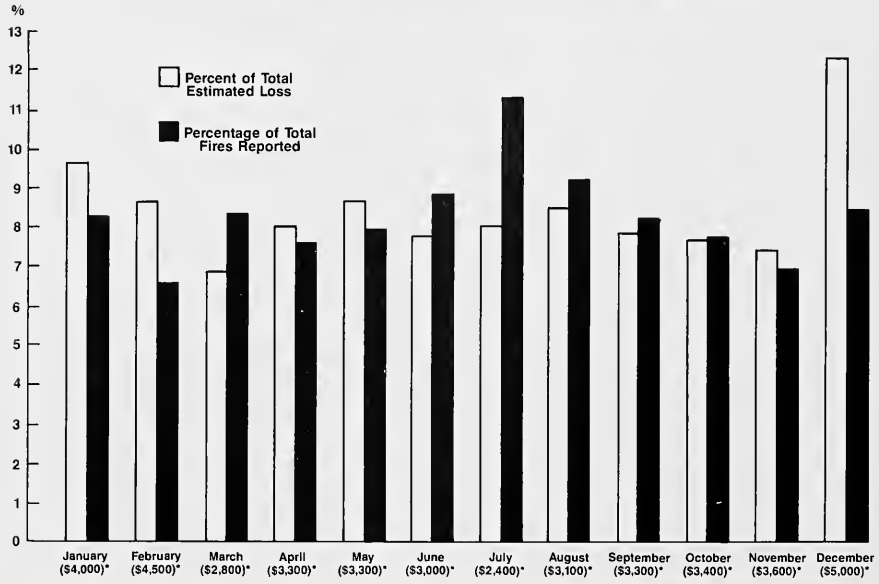


Figure 3.16 Source: NFIRS Data, 1983

Individual and aggregate data both indicate that property losses peak in winter months. Figure 3.17 demonstrates this fact and provides a breakdown of average loss per month.

PROPERTY LOSS OCCURRENCE, BY MONTH



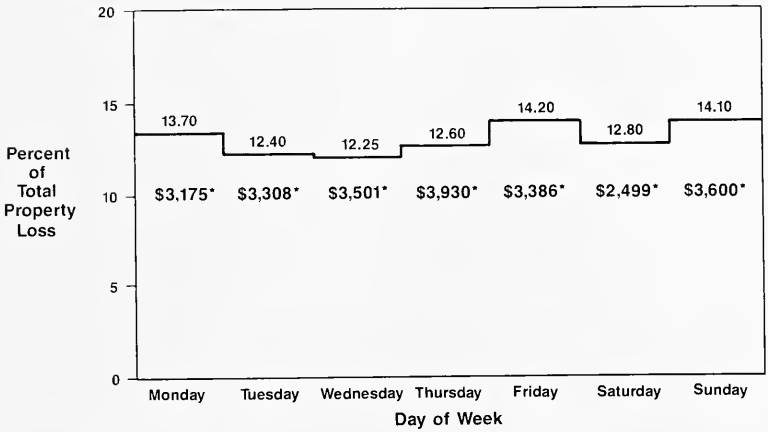
*Average Loss Per Fire by Month

Figure 3.17

Source: NFIRS Data, 1983
U.S. Fire Administration

Conventional wisdom has long held that the largest losses occur during late-night, early-morning hours and on weekends. NFIRS data supports this view. As is evident in Figure 3.18, the highest percentage of losses reported in 1983 occurred on Fridays (14.2 percent) and Sundays (14.1 percent).

PROPERTY LOSS OCCURRENCE BY DAY OF WEEK



*Average Loss Per Fire

Source: NFIRS Data, 1983
U.S. Fire Administration

Note: Eight Percent of the Occurrences Fell Within Other Categories.

Figure 3.18

A relatively small number of fires do a disproportionately large share of the damage. In 1983, about 271 fires, only .01 percent of the total, caused roughly 16 percent of the property loss for the year. It is the large-loss fire that is principally responsible for this distortion. This is demonstrated in the following tables:

LARGE LOSS FIRE INCIDENCE USING ABSOLUTE MEASURES

Category	Fires	Deaths	Injuries	Direct Property Loss
Large Loss Incidents	271	52	421	$ 885,000,000
All U.S. Incidents	2,400,000	6,100	110,000[1]	$7,000,000,000

[1]According to estimates of the U.S. Fire Administration, between 100,000 and 120,000 fire-related injuries occurred in 1983.

Table 3.13

Source: NFIRS Data, 1983
U.S. Fire Administration

LARGE LOSS FIRE INCIDENCE USING RELATIVE MEASURES

Category	Reported Fires	Deaths Per 1,000 Fires	Injuries Per 1,000 Fires	Property Loss Per Fire
Large Loss Incidents	271	16.9	1,370.0	$3,400,000
All U.S. Incidents	2,400,000	3.0	34.0	$ 3,500

Table 3.14

Source: NFIRS Data, 1983
U.S. Fire Administration

Fire authorities define large-loss fires as those causing $1,000,000 or more in property damage. The National Fire Protection Association (NFPA), which conducts an

annual study of the nation's large loss fires, has found that fires that produce major losses typically have several characteristic elements:

- large-loss fires begin late at night or early in the morning;
- large-loss fires occur in buildings with inadequate or non-existent automatic detection or sprinkler systems;
- large-loss fires occur where buildings are in poor condition or in violation of modern codes; and
- large-loss fires start where access is limited.

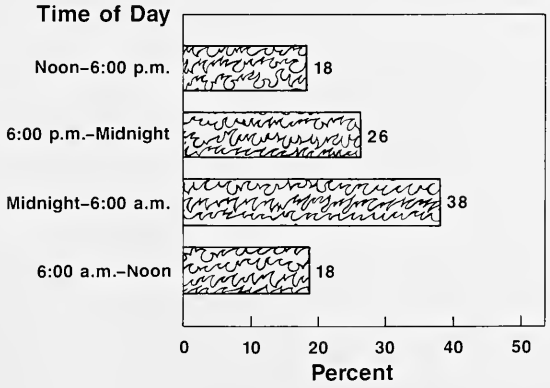
Arson is also a frequent element in large-loss fires, because, as a rule, people who set fires intentionally make stronger ones than those who have started them inadvertently.[14]

A distinct fire scenario commonly emerges as a result of these elements:

- detection of the fire is delayed;
- the fire progresses beyond the capabilities of a routine, first alarm response by the fire department;
- the fire eventually burns itself out; and
- structural collapse completes the damage of the property's contents.

Figure 3.19 provides insights regarding the time of day that fires most commonly occur.

WHEN LARGE LOSS FIRES OCCUR, BY TIME OF DAY



Source: NFIRS Data, 1983
U.S. Fire Administration

Figure 3.19

[14]For a more detailed study of large loss fires, see "Large Loss Fires, 1983" *Fire Journal* (May 1984).

As we have discussed, one of the most troublesome aspects of these major fires, from the perspective of fire research, is the tremendous damage that they cause. In 1975, a consortium of insurance companies conducted an analysis of sixteen large-loss fires; they found two characteristics particularly pervasive:[15]

- poor conditions of buildings; and
- no full-time, career fire department in the community or immediate vicinity.

While other elements are common in large-loss fires, the weight of these two characteristics is substantial. This is vividly demonstrated in the major fires that occurred in 1983.[16]

What follows is a description of four of these large loss fires:

Oil Refinery
Martinez, California

An undetected leak in an older processing unit led to an accumulation of flammable vapors. The cloud of vapors ignited from an unknown source, perhaps a heater used in the separation of oil components. Despite the efforts of several area fire departments and industrial fire brigades, the fire raged out of control for over 48 hours. The fire was not fully extinguished for a week, and salvage operations were expected to require several months.

Oil Pumping Station
Near Prudhoe Bay, Alaska

Thawing of frozen earth is believed to have been responsible for the mechanical failure of a fitting at this remote oil pumping station. In standard operating procedures for this type of pumping station, personnel are not normally at the automated facility. And, the station had little in the way of automated fire suppression equipment. Once the fire had been detected, control was achieved by remotely shutting off oil from either side of the fault. No public fire department serves this isolated area. Damage was substantially greater because of the extreme volatility (and high value) of the crude oil and the specialized nature of the equipment lost. In addition, the remote location of the site greatly increased the costs of salvage and restoration.

Shopping Center
Brunswick, Georgia

Hot, dry conditions, unsupervised buildings, and a lack of automatic sprinklers enabled this fire to get a favorable start. Arriving fire companies found nearly one-third of the complex involved in the fire. Fire fighting forces from seventeen departments were summoned under the area's Mutual Aid Plan. Roughly one-third of the shopping center was saved.

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[15]Shpilberg Colcher, David. "Statistical Decomposition of Large Loss Fires" Factory Mutual Research Corporation, 1974.

[16]See "Large-Loss Fires, 1983," *Fire Journal* (May 1984).

Shopping Center
Denver, Colorado

Originally, this shopping center had been built outside city limits and, hence, outside the control of municipal construction and fire codes. Later, as Denver expanded, this area was included within the jurisdiction of the municipality. As an existing structure, the shopping center was not required to make the necessary modifications to be in compliance with the city code. Had it been, effective automatic sprinklers and improved fire resistance in public areas and between stores would have been required. The fire occurred on an extremely windy day. As a result of these conditions, a serious fire was already in progress by the time that the first fire companies (one of which was located directly across the street from the complex) arrived. Despite limited water supplies, nearly half of the shopping center was saved.

The largest loss reported in the United States in 1983 was the refinery fire, described above, in Martinez, California. That fire, which occurred on April 7, 1983, caused nearly $50,000,000 in direct property losses. Fifteen additional fires in 1983 resulted in over $10,000,000 losses each. Together these sixteen fires created direct losses of $294,000,000. This is roughly eleven percent of the total loss for 1983, but constitutes only 0.0007 percent of the total number of fires.

It must be emphasized that claims pertaining to large-loss fires are resolved slowly. Final figures, which often are not completed for several years, are usually significantly larger than the original estimates. It may be fairly assumed, then, that existing 1983 figures are considerably underestimated.

A final exploration of the top dollar loss scenarios in fixed property use demonstrates the importance of tailoring prevention strategies to fit these problem areas.

TOP DOLLAR LOSS SCENARIOS BY FIXED PROPERTY USE IN NON-RESIDENTIAL CATEGORIES

Fixed Property Use	Time of Day	Form of Heat of Ignition	Type of Material Ignited	Form of Material Ignited	Ignition Factor
 Public Assembly	Night	Fixed Wiring	Wood	Structural Component or Finish	
	Night	Heater	Wood	Structural Component or Finish	
	Night	Electrical Equipment			
 Educational	Night	Electrical Equipment Arcing	Plastic Decorations*		
	Night	Open Flame	Flammable Liquid		Incendiary
	Night	Open Flame	Paper Stock	Books	Incendiary
 Institutional	Night	Open Flame			
	Night	Open Flame	Bedding-Textiles		Incendiary
	Night	Smoking Materials	Textile	Soft Goods	
 Store/Office	Night	Electric Wiring	Wood	Structural Component or Finish	
	Night	Open Flame		Flammable or Combustible Liquid	Incendiary
	Night	Open Flame	Wood or Paper	Supplies; Stock	Incendiary
 Basic Industry	Night	Electric Wiring		Structure	
	Day	Electric Wiring		Stock	
	Night	Electric Wiring		Stock	
 Manufacturing	Night	Electric Wiring	Stock		
	Day	Open Flame	Volatile Solid or Chemical		Misuse of Heat of Ignition
 Storage	Night	Electric Wiring	Supplies or Stock		
	Night		Flammable or Combustible Liquid		Incendiary
	Night		Wood or Paper Stock		Incendiary
 Special Property	Day	Fuel-Powered Equipment	Flammable or Combustible Liquid Fuel		Mechanical Failure or Malfunction
	Night		Flammable or Combustible Liquid		Incendiary
	Night	Wood	Structure or Finish Material		Incendiary

*This Was Only One Fire But it Resulted in Very High Dollar Loss

Table 3.15

Source: NFIRS Data, 1983
U.S. Fire Administration

CONFLAGRATIONS

One type of large-loss fire, known as a *conflagration*, requires special attention in this report. A conflagration is a large, destructive fire of sufficient fury to overcome a fire barrier. It has the capability to jump streets and destroy several—perhaps many—buildings.[17] Throughout history, major conflagrations have virtually destroyed many locales in the United States. Jamestown, the first permanent English-speaking community in the country, was also the first settlement to be annihilated by a conflagration, thereby beginning an unfortunate tradition of urban conflagrations in America.

By the late 1800s, fire defense capabilities were improved in cities—largely in response to the impetus of insurance companies. Through the years, large-scale conflagrations have become a rare, but not extinct, species of fire.

In 1983, there was no major urban conflagration. Nonetheless, the continued threat of this type of fire warrants its inclusion in this report. Consider a conflagration which occurred in Lynn, Massachusetts in 1981. Despite the united efforts of well-equipped fire departments, the conflagration raged beyond control. Fire fighters were unsuccessful until the fire reached a widening boulevard. There the fire was stopped; while there is considerable speculation, fire authorities remain uncertain why the fire was finally stopped at this point. The example is illustrative of the dilemma of conflagrations. It is an area in need of substantial research.

Today, conflagrations in this nation generally appear in one of two forms: 1) the *urban* conflagration, typified by densely packed buildings inadequate fire defenses, and 2) the *suburban* conflagration, often started or spread by brush fires, and frequently complicated by the involvement of wood shingle roofs.

Sound prevention measures naturally are the only real means of further reducing the problem of conflagrations in the nation.

[17]Fires which destroy several buildings but which do not jump streets are called "group" fires.

chapter 4

major categories of fire incidence

MAJOR CATEGORIES OF FIRE INCIDENCE

In order to better understand the nation's fire problem, the U.S. Fire Administration analyzes fire by dividing it into three major categories: structure fires, mobile property fires, and outside fires. In the following section, fire incidence in 1983 as it occurred in each of these three areas is described.

STRUCTURE FIRES

There are two classes of structure fires: residential and non-residential. Both have significant impacts on the overall fire problem in the United States. Because of the critical nature of these fires, the U.S. Fire Administration has devoted a substantial amount of attention to these topics.

RESIDENTIAL FIRES

THE PROBLEM

Residential fires form the core of the fire problem. If the incidence of these fires declined, the safety and well being of thousands of Americans would be preserved. In turn, if residential fires decreased, the working conditions and accomplishments of our nation's fire fighters would improve immeasurably. As it currently stands, however, residential fires pose a monumental challenge. Their impacts on the fire problem as a whole are strikingly evident in the following statistics:

- nearly one-half of all structure fires in the nation occur in residences;
- residential fires cause three-fourths of the nation's fire deaths;
- two-thirds of all fire-related injuries result from residential fires; and
- almost half of all property loss is due to residential fires.

The impacts of residential fires are keenly felt in still another area—indirect loss. Roughly one-fourth of all residential fires cause major indirect loss. While any precise measurement of indirect loss is well beyond the confines of this report, the effects of these losses on fire victims must be emphasized. The expenses of medical treatment, loss of income, additional expenses for temporary shelter, and other costs that arise from residential fires weigh heavily on victims. Of course, the most significant costs are often those that have no monetary value—anxiety, stress, and sorrow over the loss of loved ones and cherished possessions. Unfortunately, these immeasurable losses are common components of residential fires.

It is not merely the victims that bear these costs. American society as a whole carries a substantial burden. Consider the possible effects of a single residential fire. Assume that the fire's victims have lost virtually all their assets as a result of this fire and have suffered serious physical and emotional injuries. Medical treatment *must* be provided. Insurance forms *must* be processed. Professional counseling and other social services, when needed, *must* be delivered. And, the victims need temporary shelter, not to

mention replacement clothing, food, and other fundamental items. All these services reflect costs that must be absorbed. Still other losses arise. As a result of the fire, the local government may temporarily lose a valuable source of tax revenue. The victims or their employers may have to absorb the costs of lost work. In short, the costs associated the fire are sizable.

This section explores this large component of the fire problem.

A DESCRIPTION OF RESIDENTIAL CATEGORIES

The National Fire Incident Reporting System defines "residential property" as that where "sleeping accommodations are provided for normal living purposes." Excluded from this category are any buildings classified under institutional care. Each of the residential categories is summarized below:

One- and Two-Family Dwellings - Included in this category are residences used both seasonally and year-round, row houses separated by fire division walls, and fixed mobile homes used for residential purposes;

Apartments, Tenements, and Flats - This category encompasses multi-family quarters with individual kitchen units for individuals and families living independently of each other;

Rooming, Boarding, and Lodging Houses - This category includes any short-term or long-term living quarters where separate sleeping rooms are rented for no more than fifteen occupants. No separate cooking facilities are provided in this category of structure;

Hotels, Motels, Inns, and Lodges - This category refers to short-term living quarters where there are sleeping accommodations available for hire. To be included in this category, facilities must have the capacity to provide accommodations for more than fifteen persons;

Dormitories - This category refers to long-term living quarters provided to occupants who are not members of the same family group and who are housed in either one room or a series of closely associated rooms;

Home Hotels - Included in this category are living quarters for individuals or families living independently and on a transient basis. Facilities in this category have individual kitchens in each unit;

Other Residential Occupancies - Included in this classification are children's playhouses, outdoor sleeping quarters, and other residential occupancies.

In 1983, 233,541 residential fires were reported to the National Fire Incident Reporting System. About 60 percent of these required extinguishment by a fire department. The effects of residential fires on the overall fire problem are readily apparent in a brief look at the statistics. Table 4.1 demonstrates the comparative risks associated with these fires.

RESIDENTIAL FIRES AND THE U.S. FIRE PROBLEM USING ABSOLUTE MEASURES

Category	Reported Fires	Deaths	Injuries	Property Loss
Residential Incidents	233,541	1,679	16,313	$1,253,500,000
All NFIRS Incidents	760,939	2,312	25,705	$2,665,200,000

Source: NFIRS Data, 1983
U.S. Fire Administration

Table 4.1

RESIDENTIAL FIRES AND THE U.S. FIRE PROBLEM USING RELATIVE MEASURES

Category	Reported Fires	Deaths Per 1,000 Fires	Injuries Per 1,000 Fires	Average Property Loss Per Fire
Residential Fires	233,541	7.2	70.0	$5,400
All Fires	760,939	3.0	34.0	$3,500

Source: NFIRS Data, 1983
U.S. Fire Administration

Table 4.2

The weight of residential fire risks is evident when it is compared with the death, injury, and property loss pattern of all reported fires.

WHERE RESIDENTIAL FIRES TAKE PLACE

Seventy-nine percent of the fires reported in 1983 took place in one and two-family residences. The second ranking location of residential fires was in apartments where, in 1983, eighteen percent of the residential fires occurred. In absolute terms, the incidence of fires in other residential locales is considerably less. Hotel and motel fires, for example, although third ranking in frequency, constituted only 1.4 percent of the residential fires. A complete breakdown of the location of residential fires reported in 1983 is presented in Figure 4.1:

WHERE RESIDENTIAL STRUCTURE FIRES OCCUR, BY CATEGORY BY PERCENT OF INCIDENCE

Source: NFIRS Data, 1983
U.S. Fire Administration

Figure 4.1

In terms of sheer numbers, the crux of the residential fire problem quite obviously is centered in one- and two-family residences. This fact is further detailed in the following table:

RESIDENTIAL FIRES, BY CATEGORY USING ABSOLUTE MEASURES

	Reported Fires	Deaths	Injuries	Property Loss
One & Two Family Dwellings	185,455	1,343	11,743	$1,003,100,000
Apartments, Flats, Tenements	41,565	286	3,919	$ 193,300,000
Rooming, Boarding	666	18	137	$ 4,900,000
Motels	3,414	25	340	$ 37,700,000
Dormitories	953	4	92	$ 9,100,000
Home Hotels	197	1	22	$ 1,300,000
Other Residential Occupancies	501	1	29	$ 1,100,000
Unclassified	790	1	31	$ 3,100,000
	233,541	1,679	16,313	$1,253,500,000

Table 4.3

Source: NFIRS Data, 1983
U.S. Fire Administration

However, a more detailed examination of fires using relative measures will demonstrate that other residential categories present substantially higher risks.

WHERE RESIDENTIAL FIRES OCCUR, BY CATEGORY, USING RELATIVE MEASURES

Category	Reported Fires	Deaths Per 1,000 Fires	Injuries Per 1,000 Fire	Property Loss Per Fire
 One & Two Family Dwellings	185,455	7.4	63.7	$ 5,400
 Apartments, Flats, Tenements	41,565	6.9	83.6	$ 4,700
 Rooming, Boarding, Lodging	666	27.0	205.7	$ 7,400
 Motels, Hotels, Inns, Lodges	3,414	6.4	99.6	$11,000
 Dormitories	953	4.2	96.5	$ 9,600
 Home Hotels	197	5.0	111.7	$ 6,900
 Other Residential Occupancies	501	2.0	57.9	$ 2,100
 Unclassified	790	1.3	39.2	$ 3,900
Total Residential Categories	233,541	7.1	67.8	$ 5,400

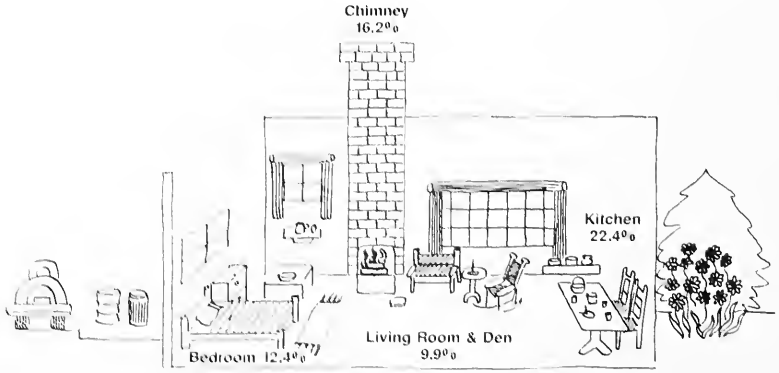
Table 4.4

Source: NFIRS Data, 1983
U.S. Fire Administration

WHERE RESIDENTIAL FIRES START

The most common areas of origin in residential fires are the kitchen, chimney, and bedroom. Over half of the residential fires reported in NFIRS in 1983 began in one of these areas. Figure 4.2 provides a further breakdown.

RESIDENTIAL FIRES, AREAS OF ORIGIN



Source: NFIRS Data, 1983
U.S. Fire Administration

Figure 4.2

HOW RESIDENTIAL FIRES START

As in other fire categories, human beings are the foremost cause[18] of residential fires. Easily over 98 percent of the fires in residences are directly or indirectly started by human involvement. In the general terms of residential fire incidence, the following cause categories figured prominently: heating, cooking, and incendiary suspicious factors. In terms of residential fire deaths, smoking, heating, and incendiary suspicious were the

[18]"Cause," in this context, is an abbreviated term for the often complex chain of events that result in a fire incident.

leading factors. The effects of various causal factors on the residential fire problem are fully detailed in the following table:

CAUSES OF RESIDENTIAL FIRES, BY TYPE OF RESIDENCE

Cause Category	1 & 2 Family Dwellings	Apartments	Mobile* Homes	Hotels & Motels
Heat	34.3%	7.1%	20.6%	10.2%
Cooking	13.6	26.4	10.8	11.3
Incendiary & Suspicious	8.4	16.2	8.6	18.5
Electrical Distribution	7.2	4.7	14.7	7.7
Smoking	4.6	13.1	5.3	22.9
Appliances	5.8	5.0	7.7	8.3
Other Equipment	5.7	6.6	4.1	3.8
Open Flames	4.7	4.5	4.4	4.7
Children Playing	3.9	5.9	3.1	1.4
Exposure	2.2	2.2	2.8	1.9
Natural Causes	1.5	0.6	1.1	1.2
Other Heat or Spark	1.0	1.0	0.9	0.9
Flammable Liquids	1.0	1.1	0.8	0.8
Flammable Gases	0.1	0.1	0.1	—
Unknown	7.0	6.7	15.9	7.3
Total	100.0%	100.0%	100.0%	100.1%

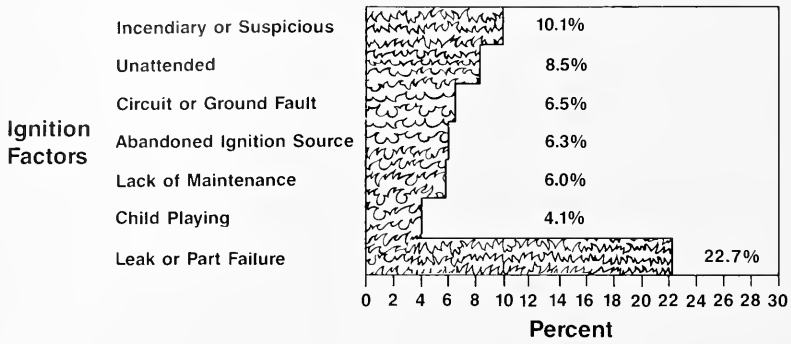
Source: NFIRS Data, 1983
U.S. Fire Administration

*Includes only those used as one-family dwellings.
Totals may not add to 100.0% because of rounding adjustments.

Table 4.5

In 1983, incendiary and suspicious fires and unattended fires were the most common factors of ignition. A detailed breakdown of ignition factors is provided in Figure 4.3.

IGNITION FACTORS IN RESIDENTIAL FIRES



Note: In 35.8 percent of the incidents reported, ignition factors were unknown or unreported.

Based on 233,541 Fires

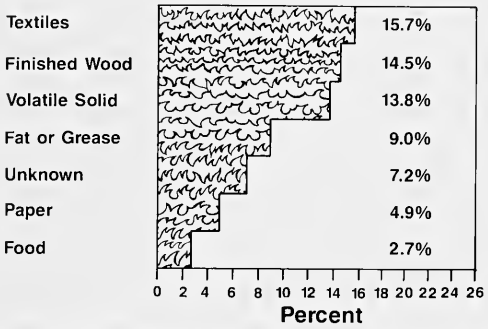
Source: NFIRS Data, 1983
U.S. Fire Administration

Figure 4.3

Interestingly, in many instances (28 percent), no equipment was involved in ignition. Analysts interpret these fires to be principally the result of lighters, matches, and smoking materials. In other known instances, cook stoves (12.0 percent), fixed local heaters (8.9 percent), chimneys (7.0 percent), fireplaces (4.4 percent), central heaters (2.6 percent), and fixed wiring (2.6 percent) were involved.

The type of material ignited is also an important consideration in examining how fires start. For fires that took place in residences, textiles, finished wood, and volatile solids were the most common materials. Figure 4.4 provides additional information pertaining to this.

TYPE OF MATERIAL IGNITED IN RESIDENTIAL FIRES



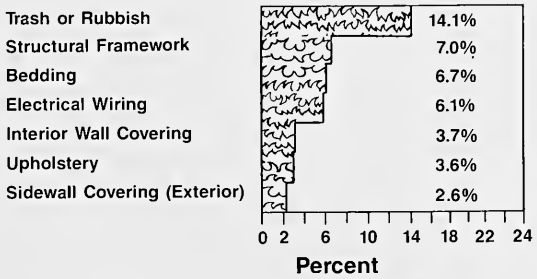
Note: The remaining 32.2% was distributed throughout the miscellaneous categories.

Source: NFIRS Data, 1983
U.S. Fire Administration

Figure 4.4

A related factor in examining how fires start in residential properties is the form of material ignited. The following figure reveals that trash, rubbish, food, or cooking materials were the most common forms of material ignited in residential fires:

LEADING FORMS OF MATERIAL IGNITED IN RESIDENTIAL FIRES



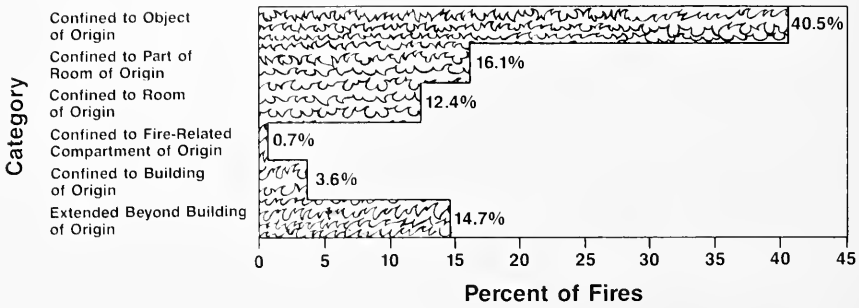
Source: NFIRS Data, 1983
U.S. Fire Administration

Figure 4.5

HOW RESIDENTIAL FIRES SPREAD

Most residential fires are relatively small. More than two-thirds (69 percent) do not extend beyond the room of origin. It is those fires which do that are a threat to both public safety and property. Residential fires that cause death, for example, commonly extend to an entire floor or building. Moreover, almost fifteen percent (14.7 percent) of the fires reported in 1983 extended *beyond* the building of origin.

FIRE SPREAD IN RESIDENTIAL FIRES



Source: NFIRS Data, 1983
U.S. Fire Administration

Figure 4.6

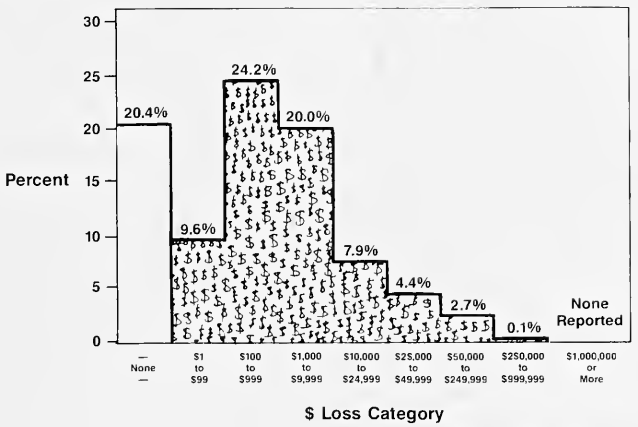
THE NATURE OF RESIDENTIAL FIRE LOSS

Thirty percent of the residential fires in 1983 NFIRS data reportedly caused $100 or less in property loss and more than 50 percent caused $1,000 or less.[19]

[19]U.S. Fire Administration analysts believe that small-loss and no-loss fires may be underreported.

Figure 4.7 illustrates the distribution of loss in residential fires.

DISTRIBUTION OF LOSSES IN RESIDENTIAL FIRES



Source: NFIRS Data, 1983
U.S. Fire Administration

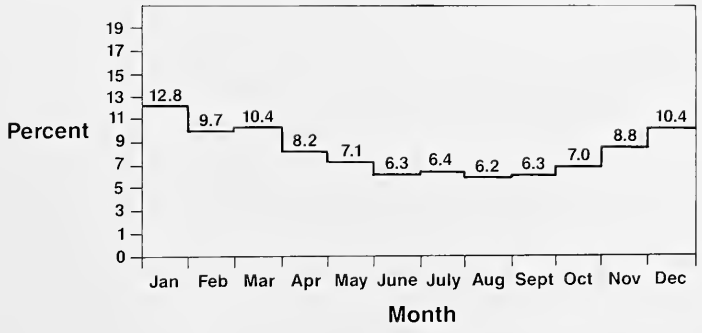
Figure 4.7

A residential fire is a tremendous equalizer: it can occur in the homes of the rich or the poor, the old or the young, and the fit or the handicapped.

WHEN RESIDENTIAL FIRES OCCUR

Residential fires have their highest occurrence rates in December, January, February, and March. Figure 4.8 illustrates this pattern.

WHEN RESIDENTIAL FIRES OCCUR, BY MONTH



Source: NFIRS Data, 1983
U.S. Fire Administration

Figure 4.8

Fires in residences are most likely to take place on Saturday through Monday.

OTHER RESIDENTIAL FIRE PROBLEMS

Any description of residential fire incidence in 1983 is incomplete without a brief overview of two topics that warrant special attention:

- mobile home fires; and
- boarding home fires.

THE PROBLEM OF MOBILE HOME FIRES

In 1983, over 9,000 fires were reported in mobile homes throughout the nation. The impact of these fires over the past two years in terms of deaths, injuries, and losses is listed below:

THE MOBILE HOME FIRE PROBLEM USING ABSOLUTE AND RELATIVE MEASURES

Category	Reported Fires	Deaths	Injuries	Property Loss	Deaths Per 1,000 Fires	Injuries Per 1,000 Fires	Property Loss Per Fire
Mobile Homes	9,785	173	631	$71,726,154	17.7	64.0	$7,300
All NFIRS Incidents	760,939	2,312	25,705	$2,665,232,714	3.0	34.0	$3,500

Source: NFIRS Data, 1983
U.S. Fire Administration

Table 4.6

When a fire occurs in a mobile home, the risk of death is more than twice as great as in other categories of residential fires. Direct property loss is higher than in residential fires despite the fact that the total pre-fire value of the mobile home property is typically less. The risk of injury is slightly, but not significantly, lower.

Fortunately, the risk of a fire occurring in a mobile home is less than in an ordinary one- or two-family dwelling. Fires occur in these structures at a reported rate of roughly one fire per 125 housing units per year. In mobile homes, the rate is about one fire to every 450 mobile homes per year. The net effect is to reduce the risk of death by fire in a mobile home slightly below the level of ordinary one- and two-family dwellings. This reduction—despite its meager amount—is impressive when one considers the history of mobile home fire incidence.

In the past, mobile homes had notable fire problems. The design of early mobile home structures enhanced fire opportunities. Heaters were located close to living and bedrooms. Interior finishes, including ceilings, consisted of combustible materials. In standard fixed structures, finishes more than likely would be made of plaster or gypsum board. Early mobile home designs commonly had only one entrance and no emergency exits.

After an unfortunate fire record, a consensus standard gradually was developed which required:

- smoke detectors;
- second doors or windows to be utilized as emergency exits;
- interior finish materials of reduced flame spread ratings; and
- cut-off utility closets for heater and water heater.

Following this effort, the U.S. Fire Administration directed related research and the Center for Fire Research at the National Bureau of Standards conducted a series of fire tests pertaining to mobile home fires. The result of all this activity was a new guideline—the Federal Mobile Home Construction and Safety Standard—issued by the U.S. Department of Housing and Urban Development. In effect, it is a modified version of the original consensus standard. While not yet perfect, the standard is responsible for considerable achievements in mobile home fire prevention.

THE PROBLEM OF ROOMING HOUSE FIRES

Rooming, boarding, and halfway houses have had a disturbing fire record over the last few years. Much of the problem is caused by the inadequate designs of these residences. Many of the structures were built years before modern codes were developed. Others were ineffectively converted from large, single-family dwellings to multiple occupancy structures. As a result, many of these facilities have open stairways, combustible interior finishes, and inadequate exits. Some structures have no smoke detectors or fire escapes. And, commonly, these residences have no attendant on duty at night.

The residents of these structures often are those who cannot afford more comfortable quarters. Some boarding-house residents are the targets of modern rehabilitation policies that favor a community-based approach for people who were formerly institutionalized. In such instances, individuals, who used to have ready access to care while in institutions, must now fend for themselves. While caseworkers argue that no community placement is made unless an individual can effectively care for him or herself, critics have raised

questions, from a safety standpoint, concerning the effects of such measures, particularly in light of the substandard state of many of these rooming residences. And, fire experience demonstrates that residents frequently encounter difficulties in the event of an emergency.

THE ROOMING HOUSE FIRE PROBLEM, USING ABSOLUTE AND RELATIVE MEASURES

Category	Reported Fires	Deaths	Injuries	Property Loss	Deaths Per 1,000 Fires	Injuries Per 1,000 Fires	Property Loss Per Fire
Rooming, Boarding, Half-Way Houses	666	18	137	$4,904,149	27.0	205.7	$7,400
All NFIRS Incidents	760,939	2,312	25,705	$2,665,232,714	3.0	34.0	$3,500

Source: NFIRS Data, 1983
U.S. Fire Administration

Table 4.7

The inherent problem of rooming house fires becomes all too clear when the risks associated with these fires are measured with residential fires in general. The risk of death from fire in this type of structure, for example, is 27 per 1,000 fires compared to 7.2 per 1,000 fires in other residential categories.

Multiple deaths are particularly pervasive when fires take place in rooming, boarding, and halfway houses. In 1983, eighteen civilians were killed in fires in these structures. Table 4.8 provides a list of multiple death fires that occurred in 1983.

MULTIPLE DEATH FIRES IN ROOMING, BOARDING, AND HALFWAY HOUSE FACILITIES IN 1983

Date	Occupancy	Civilians Killed	Civilians Injured
1/9/83	Rooming House Detroit, MI	3	0
1/17/83	Rooming House Boston, MA	4	2
2/7/83	Silver Leaves Group Home Eau Claire, WI	6	0
3/13/83	Shannons Foster Care Home Gladstone, MI	5	3
4/19/83	Central Community Home Worcester, MA	7	2
5/8/83	Boarding Home Tifton, GA	3	0
8/31/83	Anandale Village Lawrenceville, GA	8	0
10/4/83	Boarding House Austin, TX	4	0
10/21/83	Boarding House Cleveland, OH	3	1
12/5/83	Dana House Cincinnati, OH	7	3
12/31/83	Rooming House Newark, NJ	4	0

Source: NFPA, under contract to the U.S. Fire Administration

Table 4.8

Part of the popularity of short-term residences stems from their low costs—especially when compared to the high costs of institutional care. However, there seems to be a common misconception that safety measures must be sacrificed in order to maintain low costs. Many fire safety measures are not expensive: smoke detectors are one such example. So are protected exitways where walls and ceilings are coated with limited combustible interior finish. The effectiveness of such measures is dramatic. In one recent fire in a group home in Eau Clare, Wisconsin, there were two exitways. Occupants who used the protected exitway escaped successfully. Those who used the unprotected exitway died or sustained severe injuries.

A simple, relatively inexpensive sprinkler system in hallways and exits can keep passageways tenable while residents are escaping. Following two severe residential care fires in Washington, D.C., the U.S. Fire Administration offered a special grant program in order that sprinkler systems could be placed in several similar facilities. Recently, a fire broke out in one of the houses so protected. The scenario of this fire was similar to those of the other two fires, which had resulted in a total of fifteen fatalities. Each fire occurred late at night and was caused by an ignition factor where smoking materials ignited textiles. The third incident had a significant difference, however: the sprinkler system went into operation and extinguished the fire. There were no deaths, no serious injuries, and damage was confined to a couch and the area immediately surrounding it. Water damage from the sprinkler system was minimal, and, needless to say, far less than had a fire department been required to extinguish a blaze.

NON-RESIDENTIAL FIRES

THE PROBLEM

A large number of structure fires occur in non-residential property. The basic property use categories are given below:[20]

Public Assembly - Included in this category are restaurants and taverns, theaters, passenger terminals, churches, clubs, arenas, and swimming pools.

Education - This category includes the following types of schools: elementary, secondary, and collegiate; public and private; and vocational, business, and trade.

Institutions - Hospitals, nursing homes, day-care centers, orphanages, foster homes, jails, and mental institutions are all included in this category.

Basic Industry - Included in this category are power plants; communications facilities; laboratories; defense facilities; storage archives; electric and gas transmission systems; garbage and sewage disposal plants; mining and quarrying properties; and agricultural, forest, hunting, and fishing properties.

Manufacturing - This includes properties where slaughtering; canning; milling; auto and appliance production; woodworking; textile processing; chemical, plastic, and petroleum production; and printing and paper production take place.

Storage - Warehouses, garages (including those in residences), marinas, aircraft hangars, and petroleum storage tank farms are included in this category.

Stores and Offices - Property used for the display, sale, repair, or service of merchandise and property used for the provision of professional services are included in this category.

Special Properties - Included in this category are buildings under construction or demolition; vacant properties; bridges, trestles, tunnels, toll booths, telephone booths, and privies; culverts; dumps; cemeteries; roads; railroads rights-of-way; and aircraft areas.

[20]National Fire Protection Association, *NFPA Standard 901*, 1976 Edition.

For each nonresidential category, a brief summary of 1983 fire experience is provided.

PUBLIC ASSEMBLY FIRES

Throughout history, public assembly occupancies have been the unfortunate scenes of many disastrous fires that resulted in substantial loss of life and huge monetary losses. In recent years, more routine fire experience has characterized these occupancies. In terms of absolute measures, the number of deaths, injuries, and the amount of dollar loss are fairly low.

THE PUBLIC ASSEMBLY FIRE PROBLEM USING ABSOLUTE MEASURES

Category	Reported Fires		Deaths	Injuries	Property Loss
Public Assembly Incidents	14,718		17	824	$172,200,000
All NFIRS Incidents	760,939		2,312	25,705	$2,665,200,000

Table 4.9

Source: NFIRS Data, 1983

The risk of death in a public assembly fire is significantly below the average for NFIRS-reported fires. In turn, the likelihood of injury and substantial property loss is considerably higher. The following table provides a comparative breakdown of risks, using relative measures:

THE PUBLIC ASSEMBLY FIRE PROBLEM USING RELATIVE MEASURES

Category	Reported Fires		Deaths Per 1,000 Fires	Injuries Per 1,000 Fires	Property Loss Per Fire
Public Assembly Incidents	14,718		1.2	56.0	$1,200
All NFIRS Incidents	760,939		3.0	34.0	$3,500

Table 4.10

Source: NFIRS Data, 1983
U.S. Fire Administration

As in other categories of property use, several types of scenarios commonly appear in non-residential fires; these are listed in the following table:

TOP SCENARIOS IN PUBLIC ASSEMBLY FIRES

Category	Percent ot Incidence	Form of Heat of Ignition	Type of Material Ignited	Form of Material Ignited	Ignition Factor
Incidents*					
Night	2.6%	Open Flame	Wood or Paper	Stock or Finish	Incendiary & Suspicious
Injuries**					
Night	3.6%	Electric Equipment Arcing	Wood	Structural Member or or Finish	Mechanical Failure or Malfunction
Property Loss***					
Night	9.3%	Open Flame	Flammable or Combustible Liquid		Incendiary & Suspicious
Night	6.7%	Electric Equipment	Wood	Structural Component or Finish	Mechanical Failure or Malfunction
Night	5.8%	Fuel-Powered Equipment (Usually a Heater)	Fuel		Mechanical Failure or Malfunction

*Based on 14,718 Fires.
**No other scenario accounted for more than 2.0%.
***Based on 8,205 fires with $172,000,000 estimated loss.

Source: NFIRS Data, 1983
U.S. Fire ADministration

Table 4.11

The incidence of multiple deaths in public assembly fires in 1983 was minimal, particularly when compared to historical fires. During the past 100 years, there have been several tragic public assembly fires that resulted in more than 100 deaths per fire. As Table 4.11 indicates, no fires in 1983 came close to these in terms of the number of lost lives.

It appears that the lessons learned from historic fires of the past have helped to reduce their incidence in recent years. Catastrophic fires provide costly, but keen, insights into fire safety. Investigators of the Coconut Grove Night Club Fire, for example, found the number of building exits was grossly insufficient. These findings prompted a revision of exit regulations.

The big news regarding the incidence of major fires in schools in 1983—and in recent years in general—is that they were relatively few in number. In 1983, as the table below reveals, only one death and 176 injuries occurred in over 6,000 fires.

THE EDUCATIONAL PROPERTY FIRE PROBLEM USING ABSOLUTE MEASURES

Category	Reported Fires	Deaths	Injuries	Property Loss
Educational Incidents	6,613	1	176	$25,900,000
All NFIRS Incidents	760,939	2,312	25,705	$2,665,200,000

Source: NFIRS Data, 1983
U.S. Fire Administration

Table 4.12

In former years, a school fire was occasioned by the tragic loss of life. Undoubtedly, many Americans can vividly recall the horrifying journalistic accounts of the 1958 fire at Our Lady of the Angels Grade School in Chicago. Ninety-two children and three adults were killed in this fire; many leaped several stories to their deaths rather than face the flames. And, the grim toll of this fire paled in comparison to the Consolidated School fire in New London, Texas in 1937 when nearly 300 people were killed.

The likelihood of these kinds of tragedies has been greatly reduced by changes in school practices and by the use of safer construction methods and materials. Schools now have no combustible interior finishes, no students' coats hanging in hallways, and no open stairways. Exits are protected from smoke, heat, and flames through the use of fire doors. Detailed provisions are now routinely made for alarm and sprinkler systems, exits, fire safety education, and fire drill training. Moreover, new schools are commonly designed so that all rooms are at ground level, thereby facilitating escape in the event of emergencies.

Older schools—without such features—gradually are being replaced as they become obsolete. Ironically, some structures were destroyed by fires during a wave of arson that occurred throughout the nation during the turbulent 1960s and 1970s.

The improvements in fire safety in educational properties is dramatically evident. In fact, somewhat sadly, an examination of fire risk factors demonstrates that children in 1983 were safer in school than they were in their own homes.

THE EDUCATIONAL PROPERTY FIRE PROBLEM USING RELATIVE MEASURES

Category	Reported Fires		Deaths Per 1,000 Fires	Injuries Per 1,000 Fires	Property Loss Per Fire
Educational Incidents	6,613		0.2	27.0	$3,900
All NFIRS Incidents	760,939		3.0	34.0	$3,500

Source: NFIRS Data, 1983
U.S. Fire Administration

Table 4.13

NFIRS information on school fires—as the preceding table indicates—reveals a very low risk of death, and a low risk of injury. Property losses, however, are higher than the average. This pattern is the result of an unfortunate statistic: in recent years, the problem school fire typically has been caused by arson, generally such incidents occur when school is not in session. As is usually the case with arson, these fires tend to be difficult to extinguish and frequently result in substantial losses. In 1983, the average loss per educational property fire was $3,900 compared to $3,500 per fire in NFIRS overall.

Much can be learned from an analysis of the chain of events that tend to cause fires in educational properties. Table 4.14 lists the most common scenarios.

TOP SCENARIOS IN EDUCATIONAL PROPERTY FIRES

Category	Percent of Incidence	Form of Heat of Ignition	Type of Material Ignited	Form of Material Ignited	Ignition Factor
Incidents[1]					
Scenario #1	11.0%	Open Flame	Wood or Paper	General Form	Incendiary & Suspicious
Scenario #2	2.1%	Open Flame	Wood or Paper	Decorations	Incendiary & Suspicious
Deaths	Too Few for Analysis				
Injuries	Too Few Reported for Analysis				
Property Loss[2]					
Scenario #1	7.0%	Electrical Equipment			Mechanical Failure or Malfunction
Scenario #2	2.7%	Open Flame	Flammable Liquids		Incendiary & Suspicious

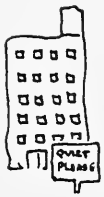
[1]No other scenario pertaining to incidents exceeded 2.0%. Based on 6,613 fires.
[2]No other scenario pertaining to property loss exceeded 2.5%.

Source: NFIRS Data, 1983
U.S. Fire Administration

Table 4.14

INSTITUTIONS

THE INSTITUTIONAL FIRE PROBLEM USING ABSOLUTE MEASURES



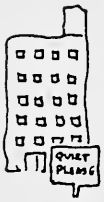
Category	Reported Fires	Deaths	Injuries	Property Loss
Institutional Incidents	6,914	15	401	$10,400,000
All NFIRS Incidents	760,939	2,312	25,705	$2,665,200,000

Source: NFIRS Data, 1983
U.S. Fire Administration

Table 4.15

As with educational properties, the fire experience in institutions has greatly improved in recent years. In 1983, there were no multiple death fires reported. In fact, less than one percent of reported fire deaths occurred in institutions. The following table details the risks associated fires in educational properties:

THE INSTITUTIONAL FIRE PROBLEM USING RELATIVE MEASURES



Category	Reported Fires	Deaths Per 1,000 Fires	Injuries Per 1,000 Fires	Property Loss Per Fire
Institutional Incidents	6,914	2.2	58.0	$1,400
All NFIRS Incidents	760,939	3.0	34.0	$3,500

Table 4.16

Source: NFIRS Data, 1983
U.S. Fire Administration

Once again, it appears that individuals confined in institutions in 1983 were safer from fire hazards than they would have been in their own homes. The death rate per one thousand fires was 2.2 in institutional settings compared to 7.1 in residential properties.

Consider the implications of such statistics: the occupants of many institutions cannot—or are not allowed—to care for themselves and, hence, cannot be expected to save themselves under emergency conditions. Ironically, it appears that some individuals fare better in terms of personal safety when they are deprived of the freedom of self-care.

In institutional fires, the injury rate is considerably higher than that for all reported fires in NFIRS. In turn, the average loss per institutional fire—$1,400—is much less than the average loss for all NFIRS fires—$3,500.

Analysts at the U.S. Fire Administration attribute these generally positive rates to improved attitudes toward fire safety. These are reflected in design, inspection, and operation of institutional facilities. As in other categories of property use, many institutional settings of the past were not built for institutional purposes. Modern fire safety standards were often out of the reach of these old-fashioned structures. The residential mansions and estates that had been converted into nursing homes; the towering hospitals with the archaic designs; the overcrowded jails and asylums so formidable in appearance —all are gradually being replaced. New structures, designed according to modern standards and practices for institutional care, are being constructed in their place. This increased attention to fire safety provisions clearly has contributed to the generally impressive institutional fire experience seen in 1983.

There is an unfortunate aspect to this picture, however. The new institutions are costly to construct and maintain. Motivated in part by fiscal considerations, social service professionals, when practicable, have moved physically and mentally handicapped individuals directly out into the communities. Similarly, many correctional institutions have implemented early-release provisions for some offenders in order to maintain occupancies at a manageable level. Such individuals often find the only available shelter is in boarding homes, rooming houses, and halfway houses. The fire safety record of these property uses is very poor.

As in other property use categories, scenario analysis can provide substantial insights regarding institutional fires. The following table details the top scenarios for fires in institutional properties:

TOP SCENARIOS IN INSTITUTIONAL PROPERTY FIRES

Category	Percent of Incidence	Form of Heat of Ignition	Type of Material Ignited	Form of Material Ignited	Ignition Factor
Incidents[1]					
Scenario #1	8.3%	Open Flame	Textile	Bedding or Clothing	Incendiary
Scenario #2	5.9%	Smoking Materials (Usually Cigarettes)	Textile	Bedding or Clothing	Misuse of Heat of Ignition
Scenario #3	7.2%	Smoking Materials	Paper		Misuse of Heat of Ignition
Deaths	Too Few for Rational Analysis				
Injuries[2]					
Scenario #1	14.0%	Open Flame	Textile	Soft Goods and Wearing Apparel	Incendiary & Suspicious
Scenario #2	5.5%	Open Flame	Wood	Structure or Finish Material	Incendiary and Suspicious
Property Loss[3]					
Scenario #1	7.2%	Open Flame	Textile	Soft Goods and Wearing Apparel	Incendiary and Suspicious
Scenario #2	2.9%	Open Flame	Flammable or Combustible Liquid		Suspicious

[1]No other scenario pertaining to incidents exceeded 5.9%. Based on 2,043 Fires.

[2]No other scenario pertaining to injuries exceeded 4.0%. Based on 401 injuries.

[3]No other scenario pertaining to property loss exceeded 2.5%. Based on 3,656 fires with an estimated $10,400,000 loss.

Source: NFIRS Data, 1983
U.S. Fire Administration

Table 4.17

In 1983, three percent of the incidents reported in NFIRS were fires in stores and office properties. The following table outlines fire activity in store and office property compared to NFIRS fires in general:

THE STORE AND OFFICE FIRE PROBLEM USING ABSOLUTE MEASURES

Category	Reported Fires	Deaths	Injuries	Property Loss
Store & Office Incidents	22,080	30	1,247	$226,000,000
All NFIRS Incidents	760,939	2,312	25,705	$2,665,200,000

Source: NFIRS Data, 1983
U.S. Fire Administration

Table 4.18

The risk of death by fire in store and office incidents is substantially lower than the average. On the other hand, based on NFIRS reports, the risk of injury from these fires is considerably higher. The loss per fire is also much higher than the average because these properties commonly have a large stock of material in one location. Table 4.19 provides a comparative breakdown of risks:

THE STORE AND OFFICE FIRE PROBLEM USING RELATIVE MEASURES

Category	Reported Fires	Deaths Per 1,000 Fires	Injuries Per 1,000 Fires	Property Loss
Store & Office Incidents	22,080	1.4	56.5	$10,200
All NFIRS Incidents	760,939	3.0	34.0	$ 3,500

Source: NFIRS Data, 1983
U.S. Fire Administration

Table 4.19

Analysts at the U.S. Fire Administration attribute the low death rates, both absolute and relative, in store and office fires to several factors:

- patrons and staff are awake, mobile, sober, and alert;
- these properties are generally well regulated by code and enforcement; and
- hazardous materials and processes are segregated from property where the public is admitted.

Further insights regarding store and office property fires can be derived from an analysis of common scenarios. The following table provides an overview:

TOP SCENARIOS IN STORE AND OFFICE FIRES

Category	Percent of Incidence	Form of Heat of Ignition	Type of Material Ignited	Form of Material Ignited	Ignition Factor
Incidents[1]					
Night	4.8%	Electric Equipment Arcing	Plastic	Insulation	Mechanical Failure or Malfunction
	3.1%	Open Flame	Wood or Paper	Stock	Incendiary or Suspicious
Deaths	Too Few for Analysis				
Injuries[2]					
Night	2.3%	Electric Equipment Arcing	Wood	Structural Component or Finish	Mechanical Failure or Malfunction
Property Loss[3]					
Night	5.2%	Electric	Wood	Structural Component or Finish	Mechanical Failure or Malfunction
Night	4.3%	Open Flame	Wood or Paper	Supplies or Stock	Incendiary

[1]Based on 22,080 fires.
[2]No other scenario pertaining to injuries exceeded 2.0%.
[3]Based on 13,833 fires of $226,400,000 estimated loss.

Source: NFIRS Data, 1983
U.S. Fire Administration

Table 4.20

A substantial number of fires in basic industry properties occurs each year. The following table, using absolute measures, presents an overview of fire activity in 1983:

THE BASIC INDUSTRIAL FIRE PROBLEM USING ABSOLUTE MEASURES

Category	Reported Fires	Deaths	Injuries	Property Loss
Basic Industry Incidents	14,974	15	285	$ 109,000,000
All NFIRS Incidents	760,939	2,312	25,705	$2,665,200,000

Table 4.21

Source: NFIRS Data, 1983
U.S. Fire Administration

In 1983, of the 760,939 fires reported in NFIRS, 14,974 basic industry fires were reported. The average amount of property reported lost from these fires is estimated at $7,300—about twice the average reported in NFIRS as a whole. This is a reflection of the utility of risk measurement: most industrial plants are worth many times the monetary value of a private dwelling. Some of the facilities that fall in this category are centers of particularly concentrated value; e.g., mines, communications centers, nuclear plants, electronic laboratories, and computer centers.

THE BASIC INDUSTRY FIRE PROBLEM USING RELATIVE MEASURES

Category	Reported Fires	Deaths Per 1,000 Fires	Injuries Per 1,000 Fires	Property Loss Per Fire
Basic Industry Incidents	14,974	1.0	19.0	$7,300
All NFIRS Incidents	760,939	3.0	34.0	$3,500

Table 4.22

Source: NFIRS Data, 1983
U.S. Fire Administration

As the preceding table indicates, the risk of death or injury is considerably less than the average fire reported in NFIRS. The comparatively low death and injury rates presumably stem from the small number of people at risk in basic industry fires. Nonetheless, serious multiple death incidents can—and do—still occur.

Most commonly, fires in basic industry properties occur when an open flame ignites a natural product; such fires result from the misuse of heat of ignition. A complete listing of leading scenarios in basic industry property fires is provided below:

TOP SCENARIOS IN BASIC INDUSTRY FIRES

Category	Percent of Occurrence	Form of Heat of Ignition	Type of Material Ignited	Form of Material Ignited	Ignition Factor
Incidents[1]					
—	9.0%	Open Flame	Natural Product	General Form	Misuse of Heat of Ignition
—	3.3%	Open Flame	Natural Product	General Form	Incendiary and Suspicious
Deaths	Too Few for Analysis				
Injuries[2]					
Day	5.3%	Open Flame	Natural Product		Misuse of Heat of Ignition
Night	2.1%	Fuel Powered Object	Flammable or Combustible	Fuel	Misuse of Material Ignited
—	2.1%			Natural Materials	Natural Conditions
Night	2.1%	Open Flame	Natural Product	General Form	Misuse of Heat of Ignition
Property Loss[3]					
Night	3.6%	Electric Equipment Arcing	Plastic	Insulation	Mechanical Failure or Malfunction
Night	2.2%	Electric Equipment Arcing	Wood	Structural Material or Finish	Mechanical Failure or Malfunction

[1]No other scenario pertaining to incidents exceeded 2.5%

[2]No other scenario pertaining to injuries exceeded 2.0%.

[3]No other scenario pertaining to property loss exceeded 2.2%.

Based on 5,314 fires of $109,000,000 estimated loss.

Source: NFIRS Data, 1983
U.S. Fire Administration

Table 4.23

Manufacturing fires represent a small component of fire activity. In 1983, only one percent of the fires reported in NFIRS were manufacturing fires as the following table illustrates:

THE MANUFACTURING PROPERTY FIRE PROBLEM USING ABSOLUTE MEASURES

Category	Reported Fires	Deaths	Injuries	Property Loss
Manufacturing Incidents	10,785	31	1,044	$ 234,889,159
All NFIRS Incidents	760,939	2,312	25,705	$2,665,232,714

Table 4.24

Source: NFIRS Data, 1983
U.S. Fire Administration

Despite such small numbers, manufacturing fires can lead to very large losses. Many manufacturing plants are huge with a large "sound value" where even a partial loss can result in millions of pre-fire dollars. Estimated losses in 1983 from manufacturing fires totaled nearly $235 million. The average loss per fire was $21,800.

The following table details the level of risk associated manufacturing fires:

THE MANUFACTURING FIRE PROBLEM USING RELATIVE MEASURES

Category	Reported Fires	Deaths Per 1,000 Fires	Injuries Per 1,000 Fires	Property Loss Per Fire
Manufacturing Incidents	10,785	2.9	97.0	$21,800
All NFIRS Incidents	760,939	3.0	34.0	$ 3,500

Table 4.25

Source: NFIRS Data, 1983
U.S. Fire Administration

As in other categories of non-residential fires, manufacturing fires in years past resulted in large loss of life. One hundred-forty-five people, for example, died in a single fire at the Triangle Shirtwaist Factory in 1911. In 1983, the risk of dying in a manufacturing fire was only 2.9 deaths per 1,000 fires—which places the risk of death from manufacturing fires slightly beneath the average rate for NFIRS fires overall.

In turn, manufacturing fire injury rates remain high when compared to rates for NFIRS fires overall.

Fire scenarios tend to be highly diverse in manufacturing fires. Unlike residential structures, which—for the most part—share common elements of design, a factory's design is contingent upon the function and nature of the factory. Consequently, the designs of these structures are extremely varied; and, so, too, are the types of factory fires which occur. In 1983, the most common scenario was involved in the incidence of only 2.2 percent of the fires. The following table outlines the top scenarios in manufacturing fires.

TOP SCENARIOS IN MANUFACTURING FIRES

Category	Percent of Incidence	Form of Heat of Ignition	Type of Material Ignited	Form of Material Ignited	Ignition Factor
Incidents[1]					
—	2.2%	Electric Equipment Arcing	Plastic	Insulation	Mechanical Failure or Malfunction
Deaths					
—	22.6% (7 Deaths)	Fuel Powered Object	Gas		Operational Deficiency
—	12.9% (4 Deaths)	Fireworks Explosion			
Injuries[2]					
Night	6.6%	Fuel Powered Object	Gas	Special Form	Operational Deficiency
Night	5.0%	Hot Object	Volatile Solid or Chemical	Special Form	Design Construction or Installation Deficiency
Property Loss[3]					
Night	3.2%	Open Flame	Wood or Paper	Supplies or Stock	Misuse of Heat of Ignition

[1]No other scenario pertaining to incidents exceeded 2.5%.

[2]No other scenario accounted for more than 2.0%

[3]Based on 10,785 fires of $235,000,000 estimated loss. No other property loss scenario accounted for more than 2.3%.

Source: NFIRS Data, 1983
U.S. Fire Administration

Table 4.26

THE STORAGE FIRE PROBLEM USING ABSOLUTE MEASURES

Category	Reported Fires	Deaths	Injuries	Property Loss
Storage Incidents	27,111	32	1,444	$ 253,115,000
All NFIRS Incidents	760,939	2,312	25,705	$2,665,200,000

Table 4.27

Source: NFIRS Data, 1983
U.S. Fire Administration

A relatively large number of fires occur in storage properties; in 1983, 27,111 fires were reported. Analysts have little indication why fire incidence is relatively high in this category of property use.

THE STORAGE FIRE PROBLEM USING RELATIVE MEASURES

Category	Reported Fires	Deaths Per 1,000 Fires	Injuries Per 1,000 Fires	Property Loss Per Fire
Storage Incidents	27,111	1.2	53.0	$9,300
All NFIRS Incidents	760,939	3.0	34.0	$3,500

Table 4.28

Source: NFIRS Data, 1983
U.S. Fire Administration

As the preceding table indicates, on the average, death rates are inclined to be low while injury rates tend to be rather high. The comparatively low risk of death undoubtedly is attributable to the sparse occupancy of storage properties. In turn, injury risks may be high because storage fires can become quite serious before they are discovered; e.g., low occupancy patterns delay the detection.

Property losses also fall well above the average. The high risk of loss is readily explainable when one contemplates the nature of these properties. Storage properties—principally warehouses—typically contain goods of great value and sometimes of substantial volume. Consider a petroleum tank farm; the property has several tanks holding 100,000 barrels of gasoline. Each barrel has a 42-gallon capacity. Assuming then a base price of $1.00 per gallon, the value is roughly $4 million per tank—an enormous loss should a fire occur.

As the preceding property use categories, an overview of the leading scenarios in storage property fires is provided:

TOP SCENARIOS IN STORAGE FIRES

Category	Percent of Incidence	Form of Heat of Ignition	Type of Material Ignited	Form of Material Ignited	Ignition Factor
Incidents[1]					
—	2.2%	Exposure	Wood	Structure Component or Finish	—
Deaths	Too Few for Analysis		—	—	—
Injuries[2]					
Night	2.6%	Unknown	Wood	Structural Component or Finish	Suspicious
Property Loss[3]					
Night	5.1%	Electric Equipment Arcing	Supplies, Stock	Mechanical Failure, Malfunction	—

[1]Based on 27,111 fires; no other storage incident scenario exceeded 2.0%

[2]No other storage injury scenario accounted for more than 2.0%.

[3]Based on 19,110 fires of $235,000,000 estimated loss; no other property loss scenario storage fires accounted for 2.0%.

Source: NFIRS Data, 1983
U.S. Fire Administration

Table 4.29

More fires typically take place in special properties than in any other fire category, including both residential and non-residential properties. In 1983, forty-seven percent of the fires reported in NFIRS occurred in special properties. The following table illustrates fire incidence, by absolute measures, in special properties:

THE SPECIAL PROPERTY FIRE PROBLEM USING ABSOLUTE MEASURES

Category	Reported Fires	Deaths	Injuries	Property Loss
Special Property Incidents	358,320	411	3,285	$ 316,200,000
All NFIRS Incidents	760,939	2,312	25,705	$2,665,200,000

Table 4.30

Source: NFIRS Data, 1983
U.S. Fire Administration

Special properties are ripe targets for fire incidence. Because special properties are often unoccupied, fires in these properties have a low risk of death and a very low risk of injury. Table 4.31 presents the relative risks of these fires in 1983.

THE SPECIAL PROPERTY FIRE PROBLEM USING RELATIVE MEASURES

Category	Reported Fires	Deaths Per 1,000 Fires	Injuries Per 1,000 Fires	Property Loss Per Fire
Special Property Incidents	358,320	1.2	9.2	$ 900
All NFIRS Incidents	760,939	3.0	34.0	$3,500

Table 4.31

Source: NFIRS Data, 1983
U.S. Fire Administration

The risk of property loss tends also to be low. In fact, average fire losses in special properties were lower than in any other category of property in 1983. Because many of these properties are vacant, under construction, or in varied stages of demolition, loss tends to be confined to the value of the damaged structure and surrounding property. In other property categories, the value of a structure and its contents often drives up the amount of loss.

Despite these relatively low risks, fires in special property pose a particular challenge. As one U.S. Fire Administration authority has observed, "Special property fires bring special problems for fire fighters." Because special properties are often vacant, a fire may get a substantial head start. Moreover, fire protection systems, if in place at all, often are inoperable or have been shut off in such properties. Partial structures, either under construction or demolition, lack structural integrity and may collapse without warning. Flooring and stairways may be missing, making access difficult for fire fighters and making favorable conditions for the fire.

Difficult access is perhaps the most common distinguishing characteristic of this property use category. Consider some examples: limited access highways; airports and aircraft in flight; tunnels and trestles; and railroad rights-of-way.

The following table lists leading scenarios for special property fires:

TOP SCENARIOS FOR SPECIAL PROPERTY FIRES

Category	Percent of Incidence	Form of Heat of Ignition	Type of Material Ignited	Form of Material Ignited	Ignition Factor
Incidents[1]					
—	4.7%	—	Flammable or Combustible Liquid	Motor Vehicles	—
—	4.6%	Unknown	—	Trash	Unknown
—	3.4%	Unknown	—	Brush	Unknown
Deaths[2]					
—	7.2%	Hot Object	Fuel	—	Operational Deficiency
—	4.1%	Fuel Powered Object	Fuel	—	Operational Deficiency
Injuries[3]					
Day	2.2%	Open Flame	Natural Product	—	Misuse of Heat of Ignition
Day	2.1%	Open Flame	Flammable or Combustible Liquid	—	Mechanical Failure or Malfunction
Property Loss	Data Inadequate for Accurate Analysis				

Source: NFIRS Data, 1983
U.S. Fire Administration

[1]No other scenario accounted for more than 3.0 percent in special property incidents. Based on 358,320 fires.
[2]No other scenario accounted for more than 2.0 percent in special property fire deaths.
[3]No other scenario accounted for more than 2.0 percent in special property fire injuries.

Table 4.32

MOBILE PROPERTY FIRES

THE PROBLEM

Transportation fires have not received much study from the fire service. The majority of the incidents—car fires and fires in waste containers—require little in the way of fire fighting resources and carry relatively low risks of death, injury, and dollar loss. However, when considered in isolated categories, these fires are significant. After residential structure fires, several categories of motor vehicle fires cause more deaths than any other property type. The number of fires, injuries, and the amount of property loss that results from these property fires is also substantial.

A NOTE ABOUT OUR METHODOLOGY

The National Fire Incident Reporting System classifies mobile property fires as those which occur in road, rail, water, air, and several other types of transport vehicles.

Road transport vehicle fires are basically passenger or freight fires involving automobiles, trucks, and buses. Although mobile homes, campers, travel trailers, and similar mobile property are routinely included in this category, they have been removed from this data for purposes of this study. Instead, these vehicles are included under their appropriate property use categories; e.g., a mobile home used as a residence is included under single-family dwellings while a mobile home used as a classroom annex is listed under educational institutions.

HOW THE FIRE PROBLEM IS AFFECTED

In 1983, 216,183 mobile property fires were reported in the National Fire Incident Reporting System. How this figure and other elements of mobile property fires compare to fire activity in general is provided in the following table:

THE MOBILE PROPERTY FIRE PROBLEM USING ABSOLUTE MEASURES

Category	Reported Fires	Deaths	Injuries	Property Loss
Mobile Property Incidents	212,450	639	3,292	$ 562,000,000
All NFIRS Incidents	760,939	2,312	25,705	$2,665,200,000

Table 4.33

Source: NFIRS Data, 1983
U.S. Fire Administration

The following table presents 1983 figures using relative measures—a useful means of gauging the level of risks associated with mobile property fires:

THE MOBILE PROPERTY FIRE PROBLEM USING RELATIVE MEASURES

Category	Reported Fires	Deaths Per 1,000 Fires	Injuries Per 1,000 Fires	Property Loss Per Fire
Mobile Property Incidents	212,450	3.0	75.5	$2,300
All NFIRS Incidents	760,939	3.0	34.0	$3,500

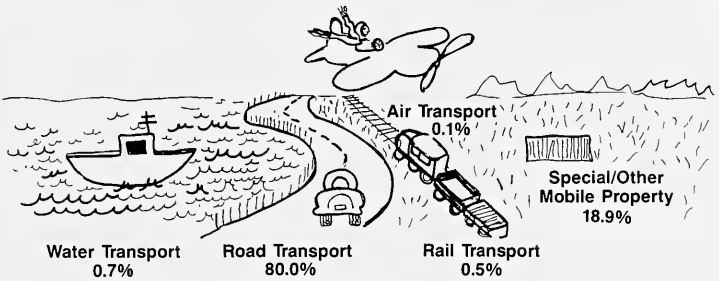
Table 4.34

Source: NFIRS Data, 1983
U.S. Fire Administration

On first glance, as the preceding table indicates, the risk of death, injury, and property loss from mobile property fires appears to be quite low. However, readers must be cautioned in their review of these data. As was mentioned previously, this comparative edge disappears when data are examined by distinct categories of mobile property; in fact, several types of mobile property fires have astonishingly high risks of death, injury, and loss. Findings pertaining to specific areas of risk in mobile property fires will be covered in subsequent sections of this unit.

Fires in categories of mobile property are distributed very unevenly. To illustrate the distribution of incidence, the following figure is provided:

WHERE MOBILE PROPERTY FIRES OCCUR



Source: NFIRS Data, 1983
U.S. Fire Administration

Figure 4.9

Typically, road transport fires are more frequent and less severe than other categories of mobile property fires. In turn, fires in ships, trains, and aircraft—while less common—tend to be more serious when they occur because of the greater values at risk. In 1983, for example, 172,497 road transport vehicle fires took place while only 224 air transport fires occurred. However, in terms of risk, the relative risk of death is 9.0 per 1,000 road transport fires in comparison to 232 deaths per 1,000 from air transport fires.

The following table provides a categorical breakdown of occurrence patterns using both absolute and relative measures:

MOBILE PROPERTY FIRES, BY TYPE USING ABSOLUTE AND RELATIVE MEASURES

Mobile Property Category	Fires	Deaths	Injuries	Property Loss	Deaths Per 1,000 Fires	Injuries Per 1,000 Fires	Property Loss Per Fire
Road Transport	172,497	402	2,184	$262,365,451	2.3	12.6	$ 1,500
Rail Transport	1,003	1	22	$ 10,852,453	0.9	21.9	$10,800
Water Transport	1,470	6	176	$ 17,780,648	4.0	119.7	$12,100
Air Transport	224	52	21	$ 7,861,705	232.0	93.7	$35,100
Heavy Equipment	3,373	1	104	$ 26,776,397	0.2	30.8	$ 7,900
Special Vehicles	22,698	2	112	$ 3,966,496	0.01	4.9	$ 200
Other and Unknown	14,918	61	462	$ 53,109,021	4.0	30.9	$ 3,600
Total	216,183	525	3,081	$382,715,171	2.4	14.2	$ 1,800

Source: NFIRS Data, 1983
U.S. Fire Administration

Table 4.35

THE ROAD TRANSPORT VEHICLE FIRE PROBLEM

Although motor vehicle fires, as a rule, tend to be less severe than other categories, the high incidence of fires in road transport vehicles warrants special emphasis.

Motor vehicle fires generally fall within three basic categories:

Fires in Vehicles Subsequent to Collision - These fires often involve gasoline or other combustible liquids and may involve occupants trapped by debris or deformation in a vehicle.

Fires in Stationary Vehicles - Similar to residential fires, these commonly start from smoking, electrical wiring, or children playing with matches or lighters.

Fires Intentionally Set in Vehicles - Arson fires tend to take place in stationary, unoccupied vehicles. While such fires carry a relatively small risk of death or injury, they do cause a large amount of property loss. It is common in some jurisdictions not to investigate the cause of motor vehicle fires so the number of arson-caused fires may well be understated.

To date, relatively little has been done in terms of auto fire prevention despite the gratifying success of fire safety activities in general. Some fire departments have responded to this problem by developing Standard Operating Procedures (SOPs) for fires in automobiles and hazardous materials carriers. These SOPs have been formulated principally as a means of reducing fire fighter injuries. By countering the hazards of flammables and combustible liquids typically involved in these types of fires with standardized practices for fighting the fires, it is felt that some gains can be made in fire fighter safety. The subject of hazardous materials in fire fighting is a topic that has gained considerable interest in recent years. It is anticipated that additional prevention efforts and strategies may be devised in response to this interest.

OUTSIDE FIRES

Any fire that does not take place in a structure or in mobile property is an outside fire. Included in this classification are fires in yard storage, crops, trees, brush, grass, trash or refuse outside buildings, outside leaks with ensuing fires, and explosions where no after fire occurs.

For the purpose of analysis, outside fires are divided into two categories:

- fires that occur in *populated* areas and are suppressed by fire departments; and
- fires that occur in *unpopulated* areas and are fought by suppression crews charged with protection of wildlands.

Outside fires are numerous and require the commitment of substantial fire fighting resources. While these fires often conjure images of blazes in desolate, wide-open spaces, they take place just as commonly in populated locales. On dry, windy days, many a large city has found itself with virtually all of its fire fighters engaged in battles against outside fires. On days where traditional festivities call for bonfires or fire works; e.g., Halloween, Election Day, or the Fourth of July, the problem of community-based outside fires becomes paramount for fire fighters. Even without such peak work loads, outside fires represent about one-third of all fires—a sizable portion.

In 1983, 299,759 outside fires were reported to the National Fire incident Reporting System. As noted before, these fires may be under reported due to the large number of no-loss and small-loss fires that typically are not reported.

HOW THE FIRE PROBLEM IS AFFECTED

The following tables illustrate the numbers and effects of outside fires in terms of both absolute and relative measures.

THE OUTSIDE FIRE PROBLEM, USING ABSOLUTE MEASURES

Category	Reported Fires	Deaths	Injuries	Property Loss
Outside Incidents	299,759*	79	1,945	$ 69,700,000
All NFIRS Incidents	760,939	2,312	25,705	$2,665,200,000

*Note: In 96% of the incidents, fires took place in "outside" categories (trees, grass, refuse, and outside of structure locations). The remaining 4% occurred in miscellaneous categories that may or may not have been out of doors. For the purposes of this report, they are classified as outside fires.

Table 4.36

Source: NFIRS Data, 1983
U.S. Fire Administration

THE OUTSIDE FIRE PROBLEM USING RELATIVE MEASURES

Category	Reported Fires	Deaths Per 1,000 Fires	Injuries Per 1,000 Fires	Property Loss Per Fire
Outside Incidents	299,759	0.3	6.5	$ 230
All NFIRS Incidents	760,939	3.0	34.0	$ 3,550

Table 4.37

Source: NFIRS Data, 1983
U.S. Fire Administration

The preceding table, in particular, provides some illumination as to how outside fires factor into the nation's fire problem as a whole.

Outside fires are not necessarily restricted to trash and brush. Contrary to popular

viewpoint, outside fires can entail major property loss. Most monetary losses, though, are well below $500. Figure 4.10 illustrates the distribution of losses in 1983:

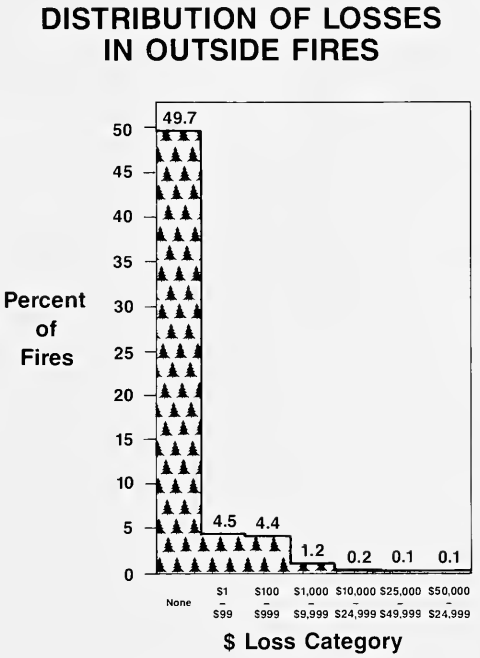


Figure 4.10

As the preceding figure indicates, although relatively uncommon, the effects of outside fires can be extreme. Fortunately, based on the number of fires reported each year, outside fires seem to be declining nationwide.

In most instances, grass and leaves are the materials that burn in outside fires. Figure 4.11 provides a breakdown of occurrence patterns in 1983.

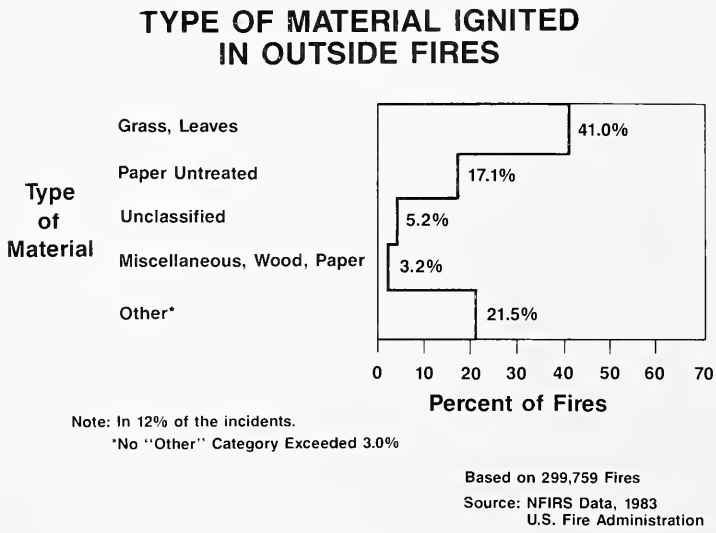


Figure 4.11

Figure 4.12 illustrates the form of material ignited in outside fires.

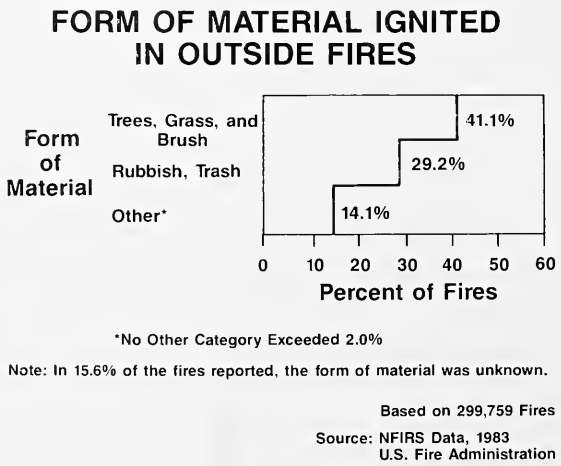
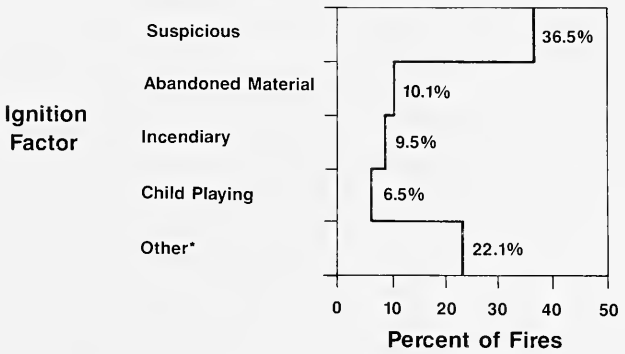


Figure 4.12

In most instances, the causes of outside fires are unknown. Where the cause of ignition is apparent, abandoned material and suspicious and incendiary factors figure prominently. Figure 4.13 provides a breakdown of ignition factors:

IGNITION FACTORS IN OUTSIDE FIRES



*No Other Category Exceeded 5%

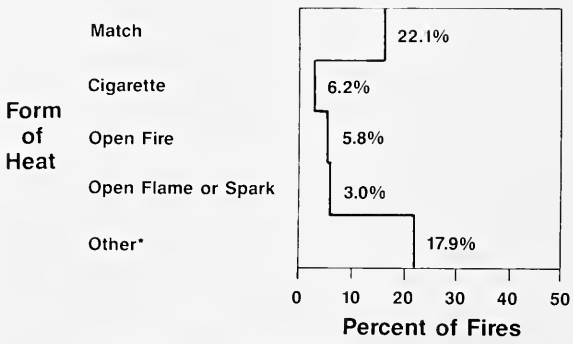
Based on 299,739 Fires

Source: NFIRS Data, 1983
U.S. Fire Administration

Figure 4.13

Matches appear to be the most common form of heat source in fire ignition. Figure 4.14 provides an overview of form of heat of ignition in fires reported in 1983.

FORM OF HEAT OF IGNITION IN OUTSIDE FIRES



*No Other Category Exceeded 3.0%

Based on 299,759 Fires

Source: NFIRS Data, 1983
U.S. Fire Administration

Figure 4.14

WILDFIRES

Fires that take place on unimproved lands or wildlands are known as wildfires. These lands may be used for grazing, timber or mineral extraction, or recreational uses. Commonly, these lands are not in use at all. Such lands typically are vast and open. Few people reside in these areas.

The low population density of these lands creates a paradox of sorts. Because few people live on these lands, the risk of human injury when fires occur is low. In turn, the likelihood that wildfires will be detected and extinguished promptly is also low because of the isolated nature of these locales. The local resources for fighting a major wildfire can be quickly exhausted; in such instances, outside assistance is necessary to bring a blaze under control.

HOW WILDFIRES ARE CONTROLLED

Protection from wildfires is the responsibility of the Division of Cooperative Forest Fire Control in the Forest Service of the U.S. Department of Agriculture. However, many fundamental responsibilities for outside fire suppression and prevention are shared among Federal participants including the Bureau of Land Management, the National Park Service, the Fish and Wildlife Service, the Bureau of Reclamation, the Bureau of Indian Affairs, the Veterans' Administration, the Department of Energy, and the armed services. In addition, all 50 states participate as do many thousands of private land-

owners. The Federal government, via the Forest Service, provides limited funding, technical direction, and resource management. Forest Service personnel also direct fire fighting crews when major fires occur. The Forest Service also makes surplus military equipment available to fire crew members for fighting wildfires. Recently, forestry equipment and crews have also been supplied and trained for fighting structural fires in rural areas.

Today, nearly two-thirds of the land area of the United States—over 1.5 billion acres—fall under the Federal Division of Cooperative Forest Fire Control.[21]

By any measure, wildfire protection looms large as one of the most successful applications of interagency, as well as public-private, cooperation. In 1982, 174,755 known fires occurred. However, less than one percent of the protected area was burned; and the average fire covered only eight acres.

HOW WILDFIRES OCCUR

Wildfires show many of the same kinds of variations that fires in populated areas do. Spring brings outbreaks of fires which peak in the dryer periods of late summer and fall. A lack of humidity and high winds make fires more likely to occur and more likely to spread. Forests, too, have their high hazard areas: large masses of combustible material in close proximity offer ripe conditions for the incidence of wildfires.

Man, as in other categories of fire, figures prominently in the cause of wildfires. Acts of nature also play a part, however. Ironically, while rain reduces the likelihood of wildfires, its common companion—lightning—is a primary cause of such fires.

HOW WILDFIRES AFFECT THE FIRE PROBLEM

New management techniques have reduced both the frequency and the severity of wildfires. Prescriptive (or intentional) burning on damp days reduces fuel loads. Any unintentional fires that occur later will do less damage and be easier to control because of the relative scarcity of fuel. Experience has proven that prevention and protection strategies are more cost effective than fire fighting.

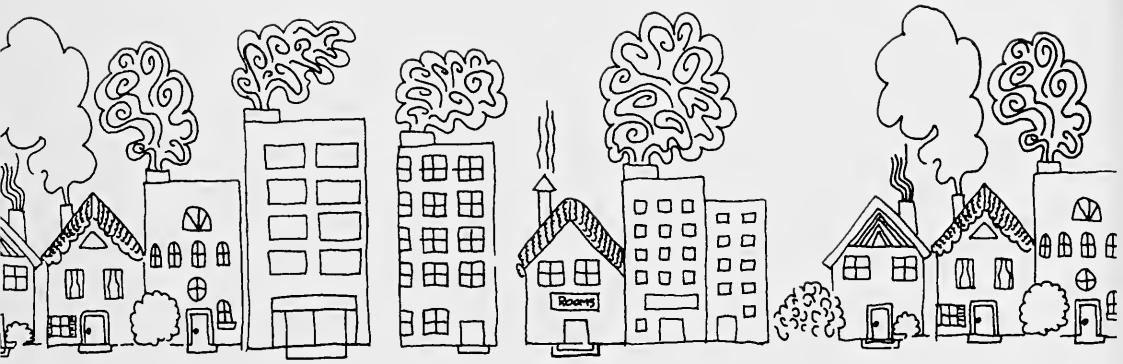
Recently, the Forest Service has decided not to fight wildland fires caused by lightning unless there is danger to life and property. Authorities maintain that these natural burns will help maintain the balance of nature in these wild areas.

Because of the decreased risk of wildfires in recent years, Federal forest fire fighting strength has been reduced from 60,000 fire fighters in 1975 to 28,000 in 1983.

[21]This is roughly 91 percent of the area eligible for such protection.

chapter 5

fire fighting: the human cost of fire suppression



FIRE FIGHTING: THE HUMAN COST OF FIRE SUPPRESSION

Information about fire fighter casualties provides an invaluable basis of understanding that can foster improvements in health and safety. When the National Fire Incident Reporting System was established in 1975, for the first time ever, there was a uniform, national data base about fire fighter deaths and injuries in the United States. Since its inception, the U.S. Fire Administration has gleaned substantial insights about patterns of injuries, deaths, and work habits among fire fighters throughout the country. Other organizations, notably the National Fire Protection Association, have also worked to improve the availability and quality of fire fighter casualty information. It is expected that this data will directly assist in the development of strategies that will reduce the incidence of casualty and that will improve the quality of life in the fire service.

The following two sections describe death and injury experience among fire fighters in 1983. The U.S. Fire Administration dedicates this section to those brave individuals who lost their lives or well-being in fighting the nation's fires.

FIRE FIGHTER DEATHS

THE PROBLEM

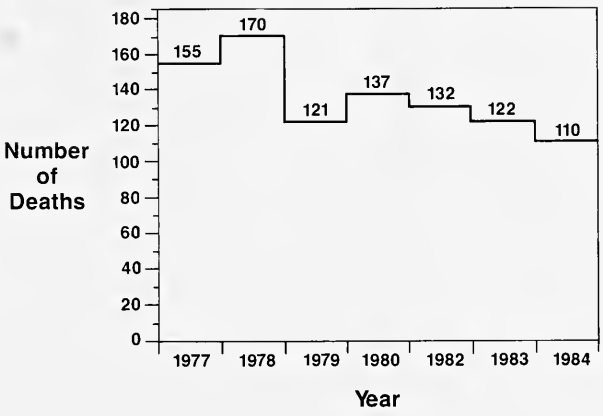
One-hundred-ten fire fighters lost their lives in the line of duty in 1983. Nearly half of these deaths (52 percent) occurred while fighting fires; slightly less than 25 percent took place when fire fighters were responding to calls. The remainder occurred in the course of training or while performing other types of emergency or routine duties.

Each year, the U.S. Fire Administration commissions an analysis of fire fighter deaths by the National Fire Protection Association (NFPA). A census-based approach is utilized for the project: NFPA staff attempt to record every fire fighter death that has occurred in the line of duty in the United States in a given year. While it is possible that a few such deaths go unrecorded, the U.S. Fire Administration and the NFPA are confident that most are detected through this data gathering approach. In the course of this research, NFPA staff also collect important data pertaining to the circumstances surrounding each death.[22]

Some interesting observations pertaining to 1983 fire deaths have been made as a result of this project. Perhaps, most notably, the project indicates that the number of fire fighter deaths which occurred in the line-of-duty is the lowest that it has been since the advent of a uniform data base. Figure 5.1 on the following page illustrates this trend.

[22]A detailed summary of the NFPA study may be found in *Fire Command*, (June 1984) page 20.

FIRE FIGHTER DEATHS, 1977-1983



Source: NFIRS Data, 1983
State Fire Marshals' Offices;

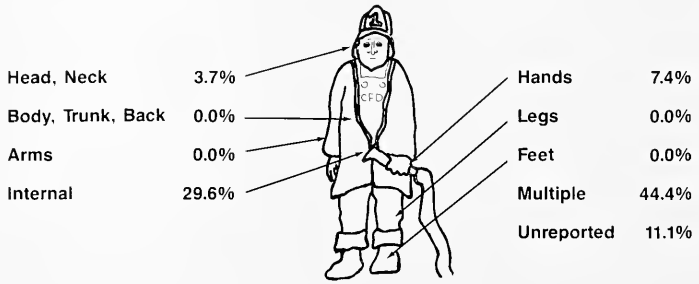
Figure 5.1

The reasons for the continuing reductions in fire fighter deaths are not fully known. Clearly, improvements in training and technology; e.g., the widespread use of self-contained breathing apparatus (SCBA), are partially responsible.

While the trend of fire fighter deaths over the past ten years has been generally downward, the *risk* of death (measured in terms of fire fighter deaths per 1,000 fires) has remained relatively constant.

A complete list of all fire fighters who lost their lives in the line-of-duty in 1983 is located in the Appendix.

THE LOCATION OF FATAL FIRE FIGHTER INJURIES

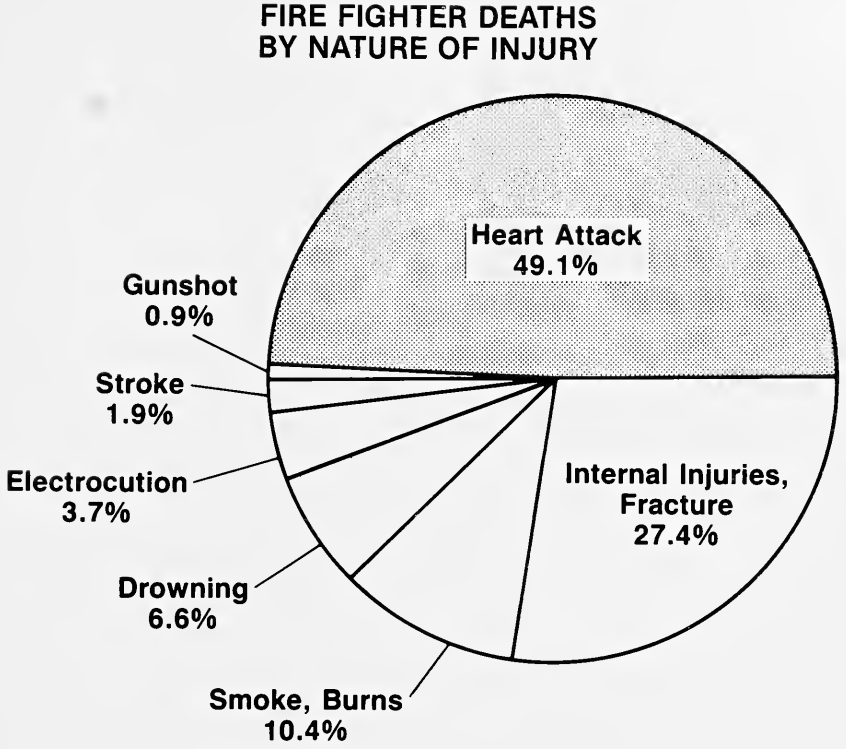


Source: NFIRS Data, 1983
U.S. Fire Administration

Figure 5.2

Individuals ill-acquainted with the risks of fire fighting are often surprised to learn that it is not smoke and burns that are the principal threat to the lives of fire fighters. In 1983, only ten percent of the victims died from burns. Heart attacks, in turn, caused roughly half of the deaths.

The reasons for the high incidence of heart attacks sustained in the line-of-duty are not fully understood. Fire authorities have speculated that both of the following factors play a part: 1) the urgency and severity of fire fighting tasks followed by lengthy, sedentary periods; and 2) the failure of the fire service to screen out potential victims.



Source: NFIRS Data, 1983
U.S. Fire Administration

Figure 5.3

In 1983, more than one-fourth of the victims died from internal injuries and fractures.

Deaths among fire fighters are not spread evenly across the country. One state—New York—was the location of 15.6 percent of the deaths that took place in 1983. More than one-third of the deaths occurred in just three states—New York, Pennsylvania, and Illinois. In turn, eighteen states had only one death each, and sixteen more had no fire fighter deaths reported in 1983.

WHERE FIRE FIGHTER DEATHS OCCUR, BY STATE, 1983

Source: NFIRS Data, 1983
State Fire Marshals' Office
National Center Health Statistics

Figure 5.4

The reasons for this unequal distribution have not been determined. Although most of the states that have large numbers of fire fighter deaths also have larger populations, the effect is not strictly proportional to population. Texas, for example, has a relatively large population but few fire fighter deaths. Some speculation regarding the cause of this disparity is possible:

- Older Urban Environments - Many deaths among fire fighters seem to occur in older cities. In these urban locales, buildings often remain standing which were built prior to modern fire safety codes. The structural integrity of these buildings often has deteriorated over time. Fires in these buildings tend to be serious, requiring complex and dangerous fire fighting techniques.

- Differences in Fire Fighting Standards and Procedures - To some extent, disparities in fire fighter death rates may be due to differences in the types of training, in the use of protective equipment, or in basic procedures pertaining to incident command and safety.

It is also possible that current methods of reporting are incomplete. If such is the case, authorities will need to rethink their analyses. At this point, however, analysts have no evidence that suggests existing methods are flawed.

HOW FIRE FIGHTER DEATHS OCCUR

By far, most deaths in the fire service take place in the actual course of fighting fires. In 1983, over half occurred from that type of duty. Over 20 percent occurred while fire fighters were responding or returning from a fire call. Figure 5.5 provides a breakdown of deaths by type of duty:

Source: NFIRS Data, 1983
U.S. Fire Administration

Figure 5.5

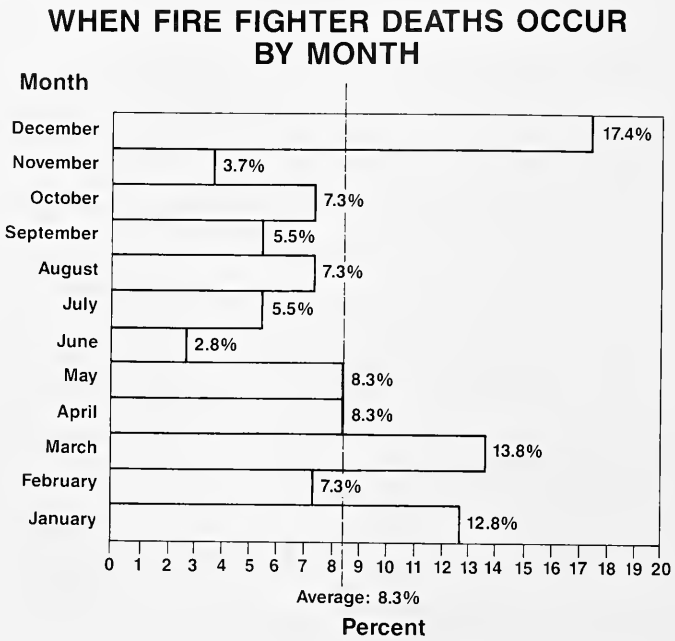
WHEN FIRE FIGHTER DEATHS OCCUR

Fire fighter deaths typically are concentrated in the winter months. Although the reasons for this have not been definitely established, fire analysts assume that the following factors are partially responsible for this pattern:

- Weather-Related Problems - Poor driving conditions; ice forming on ladders and under foot; the effects of cold weather on the body and its extremities; the loss of mobility that occurs when extra clothing is worn; and the effects of longer periods of darkness are each conditions that can impair the safety of a fire fighter.

- Fire-Related Problems - Fatal fires, multiple-death fires, and large-loss fires tend to cluster in the winter months. It is certainly plausible that these fires—substantially more serious than other types—carry a greater risk of death to fire fighters.

Figure 5.6 provides a breakdown of fire fighter death occurrence by month.



Source: 1983 Data Compiled by NFPA for the U.S. Fire Administration

Figure 5.6

WHAT ARE THE RISKS OF DEATH IN FIRE FIGHTING

The national average risk of death by fire in 1983 was about 27 per million population. Deaths among career fire fighters in 1983 were nine times the national average. There are several reasons why the rate for fire fighters is so high:

- fire fighters are exposed to more fires per person than civilians in the course of a year;
- when a fire occurs, fire fighters are going in to the fire when civilians are escaping from it; and
- fire fighters must remain at the fire until it is extinguished and until salvage and overhaul are completed.

Moreover, fire fighters are exposed to additional risks not expressly on the fire-site; e.g., motor vehicle accidents while responding to and returning from a fire. Twenty-four

deaths occurred in 1983 while responding to or returning from calls. Of these, twenty-one were the result of motor vehicle accidents. Twenty of the deaths occurred while on fire calls.

A NOTE ABOUT FIRE FIGHTER RISK

Contrary to popular belief, death rates among fire fighters are lower than in some other occupations. Career fire fighters have a work-related death rate of about 250 per million population per year. For volunteer fire fighters, the rate is roughly 52 per million persons per year.[23] Compare these death rates to those for miners and quarrymen: individuals in these occupations face a work-related death rate of 550 per million population—a substantially higher rate than those for career and volunteer fire fighters.

FIRE FIGHTER INJURIES

THE PROBLEM

National Fire Protection Association authorities estimate that 63,000 fire fighter fire injuries took place in 1983. While this figure is virtually unchanged from that of the past five years, the incidence and nature of fire fighter injuries remains a pressing problem. Moreover, in 1983, the rate of fire fighter injuries per 1,000 fires—which is a useful measure of risk—does suggest a slight increase.

To better understand the issues of fire fighter injuries, the U.S. Fire Administration annually funds an analysis of fire fighter injuries. The project, which is conducted by the National Fire Protection Association (NFPA) has two parts: 1) a survey of fire departments to estimate the number of fire fighter injuries that have taken place in a given year, and 2) an analysis of these injuries; e.g., *where*, *when*, and *why* they occurred, and *how* they can be prevented or minimized in the future. In 1983, the injury experience of 2,600 departments was used to provide the injury projections in this report.

In addition to this effort, the U.S. Fire Administration analyzes data obtained through the National Fire Incident Reporting System (NFIRS) to study general patterns and trends in fire fighter injuries. These analyses only include fire-related injuries; those which occur during routine station tasks, training, or Emergency Medical Service duties are excluded.

Findings contained in this section are principally derived from the U.S. Fire Administration and NFPA studies.

HOW FIRE FIGHTER INJURIES OCCUR

Most on-the-job injuries take place during fire control rather than in the course of rescuing, responding, returning, or while undertaking other aspects of the job. In 1983, slightly less than 75 percent of all fire fighter injuries occurred during fire control.

Not surprisingly, incendiary and suspicious fires contributed to a disproportionately high number of injuries in 1983. Generally speaking, intentionally-set fires tend to be

[23]The rate for volunteers is not precisely comparable as most of them do not work 40 hours per week, 50 weeks per year as do career fire fighters. Information necessary to calculate death rates based on hours of exposure was not available.

larger, more intense, and more damaging than fires which start by chance. Hence, such fires are inclined to be more difficult and dangerous to extinguish.

Fires where detectors were not present resulted in substantially higher casualties than where detectors were present. While research regarding detector use is insufficient to draw any substantive conclusions, it is evident that the early warning provided by detectors is one of the best means available for the prevention of deaths and injuries—including those among fire fighters.

WHERE INJURIES OCCUR

Not surprisingly, residential fires accounted for most injuries in 1983. Roughly half of all reported injuries resulted from fires in one and two-family dwellings and apartments. As was the pattern with civilian injuries, most fire fighter injuries occurred when fires originated in a bedroom, living room, or kitchen.

WHAT TYPES OF INJURIES OCCUR

Strains and sprains, wounds and cuts, asphyxia, and burns are the leading types of injuries among fire fighters. Figure 5.7 provides a breakdown of injury trends:

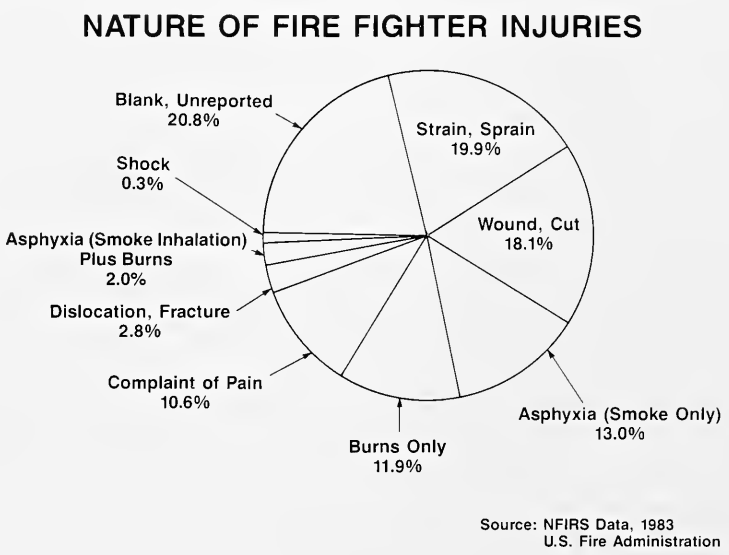


Figure 5.7

While no direct data pertaining to the severity of injuries is collected at this time, some speculation is possible based on information pertaining to the disposition of injuries. In 1983, 43 percent of the injured fire fighters were taken to the hospital for treatment; 21

percent were treated at the scene and released; and the remaining 36 percent refused assistance or treatment. Figure 5.8 provides a breakdown of injury disposition:

Source: NFIRS Data, 1983
U.S. Fire Administration

Figure 5.8

The incidence pattern of non-fatal injuries is notably different from those which result in death as the following figure illustrates:

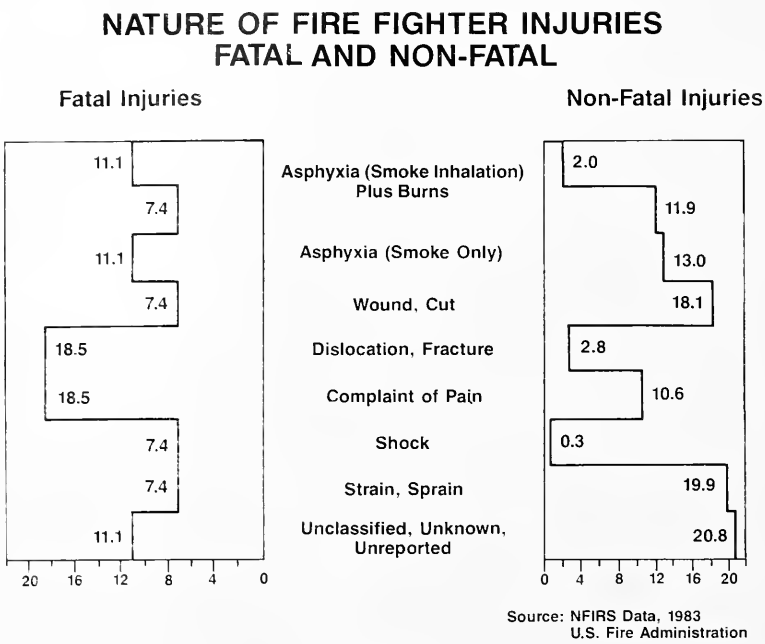
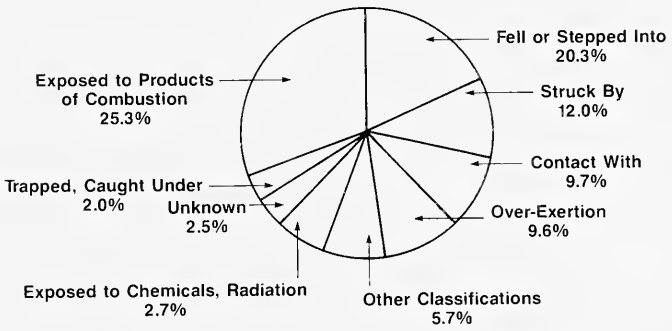


Figure 5.9

In 1983, 25 percent of the injuries to fire fighters were caused when fire fighters were exposed to products of combustion and 20 percent resulted when fire fighters fell or "stepped in". Figure 5.10 provides a detailed breakdown regarding the cause of injuries in 1983:

CAUSE OF FIRE FIGHTER INJURIES



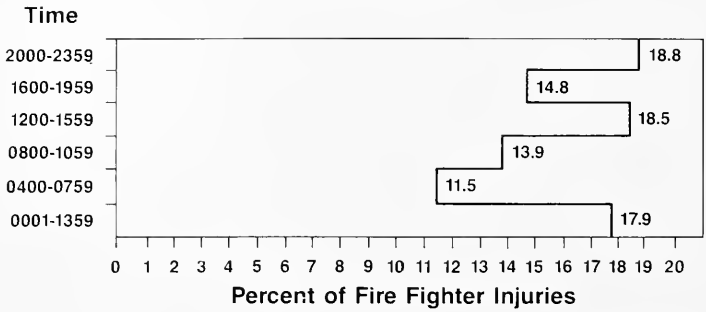
Note: Of the incident reports submitted to NFIRS, 9.7 percent of those pertaining to fire fighter injuries were left blank or were invalid.

Source: NFIRS Data 1983
U.S. Fire Administration

Figure 5.10

The peak times for fire fighter injury are late at night (between 8:00 p.m. and midnight and between midnight and 4:00 a.m.). This pattern differs from the hours when general fire incidence is at its maximum occurrence level. The reason, U.S. Fire Administration analysts speculate, is that late-night fires—while fewer in number—are more advanced and more serious by the time of discovery. Hence, these fires present a greater hazard to the safety of both fire fighters and civilians—another striking example of the fundamental need for the installation of functioning smoke detectors in all structures.

WHEN FIRE FIGHTER INJURIES OCCUR, BY TIME OF DAY

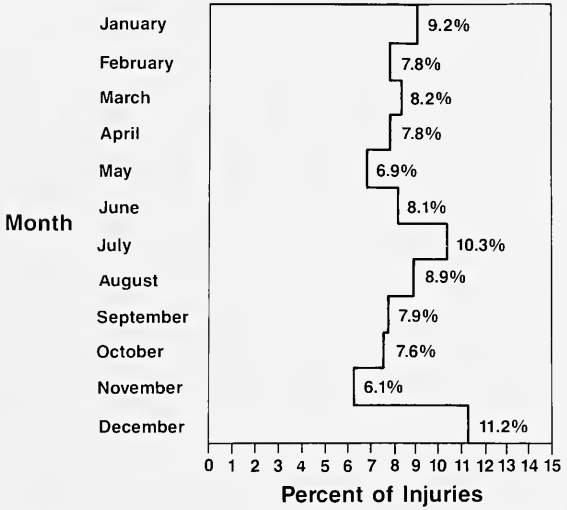


Source: NFIRS Data, 1983
U.S. Fire Administration

Figure 5.11

Injuries among fire fighters reach their highest point in the winter months. Each year, a curious peak also occurs in the month of June. Analysts have found no explanation for this occurrence. Injuries also increase moderately on weekends. As analysts' conjecture pertaining to late-night and early-morning injuries, perhaps this pattern is attributable to slower rates of detection.

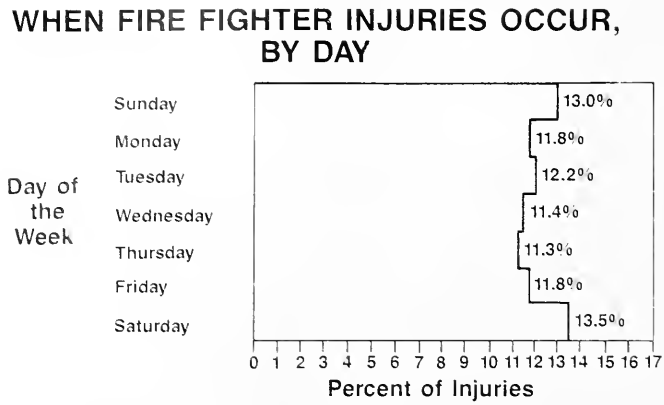
WHEN FIRE FIGHTER INJURIES OCCUR BY MONTH



Source: NFIRS Data, 1983
U.S. Fire Administration

Figure 5.12

Figure 5.13 illustrates when injuries occur by day of the week:



Note: Of the Incidents Reported, 13.8 Percent Were Left Blank.
Percentages Do Not Total 100 Percent Due to Rounding Adjustments.

Source: NFIRS Data, 1983
U.S. Fire Administration

Figure 5.13

WHO IS INJURED

In 1983, 2,433 male fire fighters were reported injured in NFIRS, in the line of duty; this compares to only 138 incidents of injury reported among female fire fighters.[24] NFIRS analysts attribute this disparity to the preponderance of male fire fighters among reporting fire departments rather than to different injury experience. However, only time and the collection and analysis of more data will provide any conclusive findings.

[24]In an additional 10,005 cases reported to NFIRS, the sex of the injured fire fighter was unknown, unreported, or unclassified.

chapter 6

special topics

SPECIAL TOPICS

Several aspects of the fire problem warrant special attention. In this section, we address the following topics:

- alternative heating fires;
- arson;
- smoking-related fires;
- clothing fires; and
- military fires.

The first three topics—alternative heating fires; arson; and smoking-related fires—are included as examples of critical problems in need of resolution. In turn, clothing fires and military fires are included as positive examples of the progress that has been—and can be—made in the area of fire prevention.

ALTERNATIVE HEATING SOURCE FIRES

THE PROBLEM

In the past ten years, the use of alternative methods for heating homes has increased dramatically. Today, the traditional method of heating—by a central unit—is often supplemented or replaced by local heating systems. These local systems are sometimes *fixed;* e.g., wood stoves, chimneys, stationary electric units, and fireplaces, and sometimes *portable;* e.g., kerosene, electric, and gas space heaters. The increased use of both portable and fixed heating devices has been paralleled with a substantial increase in fires associated with these units. This rise in alternative heater fire incidence has taken place at a time when residential fires from most other sources are decreasing. Alternative heating fires are a particularly troublesome threat to life and property when used as the primary heat source.

THE ALTERNATIVE HEATING FIRE PROBLEM USING ABSOLUTE MEASURES

Category	Reported Fires	Deaths	Injuries	Property Loss
Alternative Heating Incidents	23,312	176	1,241	$ 122,111,000
All NFIRS Incidents	760,939	2,312	25,705	$2,665,200,000

Table 6.1

Source: NFIRS Data, 1983
U.S. Fire Administration

In 1983, 23,312 alternative heating fires were reported in the National Fire Incident Reporting System. These fires resulted in 176 reported deaths, 1,241 reported injuries, and an estimated $122,111,145 in property loss. A relative measurement of these figures —to determine the amount of risk associated these fires—is particularly startling:

THE ALTERNATIVE HEATING FIRE PROBLEM USING RELATIVE MEASURES

Category	Reported Fires	Deaths Per 1,000 Fires	Injuries Per 1,000 Fires	Property Loss Per Fire
Alternative Heating Incidents	23,312	7.6	53.2	$5,200
All NFIRS Incidents	760,939	3.0	34.0	$3,500

Table 6.2

Source: NFIRS Data, 1983
U.S. Fire Administration

Alternative heating fires are much more deadly than other types of fire. Although alternative heating fires account for less than 10 percent of all structural fires, the chances

of dying should such a fire occur is 1.5 times greater than in the average fire. The likelihood of death from portable heater fires is even higher—roughly ten times greater than from an average fire.

A NOTE ABOUT THE CONTENT OF THIS SECTION

In recognition of the severity of the problem, the U.S. Fire Administration funded a survey and analysis of alternative heating fires, which was conducted by the International Society of Fire Service Instructors (ISFSI). For this project, major fire service organizations solicited reports from selected fire departments throughout the nation.[25] The fire reports were then analyzed and compared with various safety standards.

Because of the project's small data base and the self-reporting method of data collection, research findings may not be fully representative of national patterns. Nonetheless, the project is highly useful for the insights it has provided on fire scenarios of alternative heater fires. Moreover, it has served to confirm some of the findings of data obtained through the U.S. Fire Administration's National Fire Incident Reporting System (NFIRS).

Much of the material contained in the following sections is summarized from the ISFSI project.

FIXED LOCAL HEATERS

FIXED LOCAL HEATER FIRES USING ABSOLUTE AND RELATIVE MEASURES

Category	Reported Fires	Deaths	Injuries	Loss	Deaths Per 1,000 Fires	Injuries Per 1,000 Fires	Property Loss Per Fire
Fixed Local Heater Incidents	20,031	87	779	$75,300,000	4.3	39	$3,800
All NFIRS Incidents	760,939	2,312	25,705	$2,665,200,000	3.0	34	$3,500

Table 6.3

Source: NFIRS Data, 1983
U.S. Fire Administration

[25]Besides ISFSI, cooperating organizations included the Citizens Committee for Fire Protection (CCFP), the National Fire Protection Association (NFPA), and the International Association of Fire Chiefs (IAFC).

Fires from fixed local heaters increased 18.5 percent between 1982 and 1983. While the number of injuries declined 11.2 percent and the relative risk of death decreased from 5.2 to 4.4 per 1,000 fires, these fires continue to represent a serious threat to fire safety. Moreover, although improvements in injury and death rates were realized in 1983, the estimated amount of property loss was more than three times larger than in 1982.

Four types of heaters fall in this category: solid fuel, gas, electric, and liquid fuel. The following table provides a breakdown of fire activity in each category:

FIXED LOCAL HEATER FIRES, BY TYPE OF FUEL, USING ABSOLUTE AND RELATIVE MEASURES

Category	Reported Fires	Deaths	Injuries	Deaths Per 1,000 Fires	Injuries Per 1,000 Fires
Solid	14,823	45	402	3.0	27
Gas	1,751	15	160	8.6	91
Electric	740	10	54	13.5	73
Liquid	554	4	37	7.2	67

Table 6.4

Source: NFIRS Data, 1983
U.S. Fire Administration

As the preceding table indicates, it is the solid fuel heater fires—wood stoves, fireplaces, inserts, chimneys, and connector pipes—where fire incidence is highest.

Solid Fuel Heaters - Solid fuel heating devices constitute the largest single source of fires in one- and two-family homes. In the alternative heater fire survey conducted by the International Society of Fire Service Instructors (ISFSI), the number of solid-fuel fires exceeded all other types of heater fires combined.

Most of the solid-fuel fires reported in the ISFSI survey were chimney fires, starting largely from creosote accumulation. Many of these fires resulted from insufficient chimney cleaning and maintenance. However, recent research also indicates that even chimneys that are properly cared for have some risk of ignition.

Improper installation also was a common cause of fires in chimneys and other solid fuel devices. In the report on alternative heater fires, the ISFSI commented on "one alarming aspect" of the installation problem—"many inspectors and 'professional' installers may not be trained adequately."

Another cause of several solid fuel heater fires in the ISFSI survey was the improper storage of ashes. In such instances, fresh ash had been stored in paper bags or cardboard containers. Another hazardous practice related to solid fuel heater fires involved the use of flammable or combustible liquids to start a fire in a stove or fireplace. In the ISFSI survey, eight fires falling within this category occurred; of these, seven resulted in death or injury.

Given the high incidence of solid heater fires, it is fortunate that the risks of death, injury, and loss tend to be less severe than in fires in other fixed alternative heater categories.

Other Fixed Local Heaters - While fires from fixed electric local heaters do not occur frequently, when they do take place they pose grave risks. In 1983 NFIRS reports, 13.5 deaths per 1,000 fires and 73 injuries per 1,000 fires resulted from this type of fire. Fixed gas local heaters, based on 1983 NFIRS data, carried an even higher risk of injury—91 per 1,000 fires—but the risk of death was slightly lower (8.6 per 1,000 fires). Fixed liquid local heaters also present high risks of death—7.2 per 1,000 fires—and injury, 67 per 1,000 fires. However, liquid fixed heater fires are less common; in 1983, 554 incidents were reported.

PORTABLE LOCAL HEATERS

Portable heater fires create a more critical problem than fires caused by fixed local heaters. In 1983, portable local heaters accounted for 1.2 percent of all structure fires. The number of incidents in this category increased by 10 percent between 1982 and 1983. Injuries increased by 33 percent and the death rate per 1,000 fires increased by 51 percent. The following table provides an overview of the fire problem with regard to portable local heaters:

PORTABLE LOCAL HEATER FIRES USING ABSOLUTE AND RELATIVE MEASURES

Category	Reported Fires	Deaths	Injuries	Property Loss	Deaths Per 1,000 Fires	Injuries Pere 1,000 Fires	Property Loss Per Fire
Portable Local Heater Incidents	3,281	89	462	$ 46,364,794	27	141	$14,300
All NFIRS Incidents	799,939	2,312	25,905	$2,065,202,714	3.0	34.0	$ 3,500

Table 6.5

Source: NFIRS Data, 1983
U.S. Fire Administration

While not numerous, portable local heater fires are particularly dangerous. The death rate per 1,000 structure fires was 6.5 in 1983; for portable heater fires, it was 27—a death rate four times greater than the average structure fire.

Portable local heaters fall within three categories: liquid-fueled, e.g., kerosene; electric; and gas. The following table provides a breakdown of fire activity by category of heater:

PORTABLE LOCAL HEATER FIRES, BY TYPE OF FUEL, USING ABSOLUTE AND RELATIVE MEASURES

Category	Reported Fires	Deaths	Injuries	Deaths Per 1,000 Fires	Injuries Per 1,000 Fires
Liquid	856	24	167	28	195
Electric	680	16	104	24	150
Gas	476	12	75	25	160

Table 6.6

Source: NFIRS Data, 1983
U.S. Fire Administration

Because of the magnitude of kerosene heater fires and the high risk of death, this topic is extensively addressed in the next section. Below is a treatment of other categories of portable heaters in substantially less detail.

Kerosene Heaters - According to NFIRS data, the most common type of portable heater fire in 1983 was that originating in kerosene fueled heaters. In the ISFSI survey, kerosene heater fires most often occurred when the heater suddenly flared up or began smoking heavily. Many of these fires were minor and easily extinguished. However, as analysts of the ISFSI data observed, because such flare-ups can occur spontaneously, they pose a critical threat to individuals and families that use the heaters while sleeping. According to U.S. Fire Administration analysts, liquid-fueled heaters—principally kerosene-fueled—had the highest risk of death based on 1983 NFIRS data. Improvements in industry regulation of this problem have been impeded to some extent because the causes and characteristics of flare-up are not thoroughly understood.

A second cause of kerosene heater fires is the use of improper fuel. According to ISFSI analysts, in many fires, gasoline, instead of kerosene was accidentally placed into the heater. Often, this was caused when the principal user of a heater kept different types of fuel in two unmarked containers. A fire occurred when someone else, unaware of the distinction, incorrectly filled the heater's fuel from the wrong container. Some States have rectified this problem through legislation that prohibits service stations and other dispensers from selling kerosene in improper containers.

A third—and particularly severe—type of kerosene fire is caused when heaters are placed in proximity to combustibles. In the ISFSI survey, 21 such fires occurred which resulted in seven deaths. According to ISFSI analysts, the severity of these fires may have been predicated by the manner in which the fires began. As a general rule, when an ordinary combustible (Class A): e.g., wood, paper, or textiles, is located too near a heater, the material begins smoking well before it ignites. Given this characteristic, when a heater is monitored by a responsible party, there should be sufficient time to prevent a fire from occurring. In turn, this assumption suggests that when a fire of this type takes place, no responsible individual was present—thereby enabling the fire to develop and become powerful.

ISFSI analysts also noted that many of the fires caused by heaters placed too close to combustibles occurred in mobile homes. Analysts speculate that these incidents in part, may have been due to the tight spaces that are standard in many mobile homes. Such fires may also be attributable to the types of materials used in mobile home construction.[26]

Some fires are caused by kerosene igniting *outside* the heater. Of 24 such fires reported in the ISFSI survey, eight were caused by fuel leaks, four by tip-overs, and nine by fuel spilling when units were refilled.

The ISFSI survey provided particularly valuable insights regarding consumer behavior. Many incidents reflected a pervasive disregard concerning safety advice in heater use. In 32 of the 228 kerosene fires reported, the heater was left on while people slept; in seven reports, children were left in charge of heaters; in three reports, the user was intoxicated; and in 21 reports, the heater was left on while unattended.

Electric Heaters - Based on the findings of the ISFSI survey, electric heaters have a higher death rate than all other heater fires. Of 122 residential fires reported to ISFSI, seventeen deaths and eighteen injuries occurred from electric heater fires.

Where cause of fatal fires was reported, in all but two instances deaths took place as a consequence of the tendency of users to place the heaters in the bedroom while sleeping. The fires occurred when the bed was ignited by radiation or when an individual inadvertently tossed the bed clothes over the heater.

In their report, ISFSI analysts suggested several solutions to the problem of electric heater fires, including more strict UL (Underwriters Laboratories) tests. Another approach suggested is the development of a standard regulating the flammability of beds and bedclothes. A final suggested response to the problem is expanded public education measures. Many individuals believe that electric heaters pose little threat to fire safety and, hence, users become careless in their operation.

A number of electric heater fires were caused by short circuits and overloads. Of these, most malfunctions were in the plug or cord of the heater giving cause for some speculation that cords and plugs may need more rigorous testing.

ISFSI analysts noted "a surprisingly large number" of electric heater fires took place in multiple dwellings. Given the potential threat to the safety of occupants, ISFSI analysts question whether electric heaters should be allowed in multiple dwellings.

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[26]Readers interested in obtaining additional information about this topic should read the ISFSI report. Reports may be ordered by contacting: Office of Fire Data and Analysis, U.S. Fire Administration, Emmitsburg, MD 21727.

Gas Heaters - In the ISFSI study, 87 incidents concerned fires associated with natural gas heaters. Most of these fires were caused by combustibles—particularly clothing—placed too close to heaters. ISFSI analysts noted that no testing measures are currently in effect regarding the tendency of gas heaters to ignite combustibles when they are placed in proximity to heaters for any significant period.

Another cause of fires involving gas heaters resulted from equipment malfunctions. Five of the fires in the ISFSI study were caused by gas leaks and five were caused by heaters installed too near combustibles.

A FINAL NOTE

In some instances, the term, "alternative heating," may be a misnomer. In recent years, an unusually severe type of fire has been reported where alternative heating devices were in fact the *only* source of heating used in a structure. (These fires occurred in weather conditions of sufficient coldness to necessitate homes be given extra heat in order for occupants to maintain reasonable comfort, health, or even survival.) These fires took place where central heating was temporarily unavailable; e.g., as a result of equipment malfunction, power failure, non-payment of heating bills by residents; or because there was no central heating system. The use of alternative heating units as a primary or sole heating source in residential occupancies should become a prime target for inspection and public education programs.

ARSON—INCENDIARY AND SUSPICIOUS FIRES

Arson is a major ingredient of the nation's fire problem. Not only does arson represent a particularly vicious experience for its victims, it also causes substantial costs to society as a whole. Because of the maleficent nature of arson, the precise number of cases that occur each year is not known. However, fire authorities have been able to derive some useful data regarding the magnitude of the problem.

HOW ARSON AFFECTS THE FIRE PROBLEM

The number of reported arson cases has remained relatively stable in recent years. The Federal Bureau of Investigation's Uniform Crime Reporting System and the National Fire Protection Association both report that arson rates are virtually unchanged—

up or down only a percent or two. Similarly, as the following table indicates, the National Fire Incident Reporting System has found that arson incidents have increased only slightly between 1982 and 1983. When increases in the general population are taken into account, the "increase" in arson reports actually translates into a slight decrease.

THE ARSON PROBLEM, USING ABSOLUTE MEASURES

Year	Reported Fires	Deaths	Injuries	Property Loss
1983	130,469	322*	4,482	$568,500,000
1982	129,614	242	4,195	$653,000,000

*Includes civilian and fire fighter deaths.

Table 6.7

Source: NFIRS Data, 1983
U.S. Fire Administration

The following table also reveals some improvements in the area of risk:

THE ARSON PROBLEM USING RELATIVE MEASURES

Year	Reported Fires	Deaths Per 1,000 Fires	Injuries Per 1,000 Fires	Property Loss Per Fire
1983	130,469	2.5	34.0	$4,400
1982	129,614	1.86	32.3	$5,000

Table 6.8

Source: NFIRS Data, 1983
U.S. Fire Administration

Despite these improvements, casualties from such fires were relatively heavy. Of 25,705 injuries reported in NFIRS, 4,482 resulted from incendiary and suspicious fires. Four fire service deaths out of 27 reported to NFIRS, and 318 out of 2,312 civilian deaths were caused by incendiary and suspicious fires.

Risk rates are shown in the preceding tables. Overall, the risk factors of arson-related fires are not particularly high. We might expect high risks since these fires are intentionally set, not the result of chance: but it is not so. On a national scale, according to U.S. Fire Administration projections, this translates to approximately 400,000 fires, 850 deaths, 23,000 injuries, and $1.4 billion in damages.[27]

The following table compares arson patterns to fires in general:

ARSON FIRES AND THE U.S. FIRE PROBLEM
A COMPARISON OF RISKS USING RELATIVE MEASURES

Category	Reported Fires	Deaths Per 1,000 Fires	Injuries Per 1,000 Fires	Property Loss Per Fire
Arson Incidents	130,469	2.5	34.4	$4,400
All NFIRS Incidents	760,939	3.0	34.0	$3,500

Table 6.9

Source: NFIRS Data, 1983
U.S. Fire Administration

[27]These figures do *not* include wildfires of incendiary origin of which about 120,000 are reported annually.

As has been true for several years, several property use categories have severe problems with incendiary and suspicious fires.

The following table indicates where arson is most prevalent, by property use category.

THE ARSON PROBLEM, BY FIXED PROPERTY USE

Fixed Property Use	% Fires Believed to be Arson
Public Assembly	21.6% (3,644)
Education	48.1% (3,272)
Institutions	26.3% (2,095)
Residences	10.1% (30,494)
Store & Office	20.3% (5,125)
Basic Industry	7.9% (2,440)
Industrial	7.0% (1,030)
Storage	23.8% (6,550)
Special Property	54.4% (42,508)

Source: NFIRS Data, 1983
U.S. Fire Administration

Table 6.10

Special property—general structures under demolition, abandoned and vacant — are regularly the scene of arson. More than half the fires, 54 percent, in these structures are intentionally set. In schools, just under half are intentionally set. In institutions and in warehouses the rate is about a fourth—26 percent and 25 percent respectively.

Other major scenes of arson are vehicles, outdoor property, trash outside of buildings and grass, brush and forest lands. About one in five of these fires is intentionally set. However, about half those fires are of unknown origin. Outside and vehicle fires are frequently not as carefully investigated as structure fires, so proportions may actually be higher.

WHEN DOES ARSON OCCUR

Incendiary and suspicious fires begin to increase in the evening and peak in the early morning hours.

Close to 16 percent of all incendiary and suspicious fires occurred on Saturdays and Sundays. Figure 6.1 details the occurrence rate by day of the week.

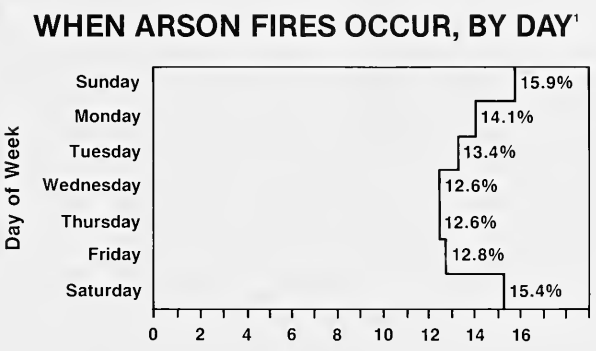

Figure 6.1

[1]Unknown Equal to 3.2%

WHY DOES ARSON TAKE PLACE

For over 150 years, researchers have studied fire setting behavior in an attempt to understand the motivations and characteristics of arsonists. The body of knowledge regarding fire-setters still remains limited. The varied profiles of arsonists have long made the subject a problematic field of study.

Today, to facilitate their research, many authorities tend to classify fire setters into one of several categories. This enables the distinct motivations of each category of fire setters to be studied independently. One researcher,[28] for example, has identified the following five categories of fire setters: 1) nonpsychologically motivated fire setters; 2) juvenile and adolescent fire setters; 3) compulsive fire-setters or pyromaniacs; 4) psychotic fire setters; and 5) female fire setters. This approach has enabled researchers to determine that while all groups may share some of the same motivations, each category also has its own specific characteristics. One authority has observed that there are also several striking features that are shared among all groups of fire setters: a history of delinquency; psychosexual problems; a distressed family unit; a pattern of alcohol abuse; and—in adult fire setters—below normal intelligence.[29]

WHAT ARE THE PROJECTED TRENDS IN ARSON

In residential occupancies, arson continues to be a particularly serious component of the fire problem. In 1983, a total of 233,541 fires in residential occupancies were reported in the National Fire Incident Reporting System (NFIRS), and 11.8 percent of those fires presumably were the result of arson.

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[28]Neil H. Blumberg, M.D. " Arson Update: A Review of the Literature on Firesetting." *Bulletin of the AAPL* Vol. 9, No. 4, Arson Update pp. 255-263.

[29]Ibid.

SEPARATING FACT FROM FICTION

Arson is the subject of some disturbing truths and frequent misconceptions. We hope the following information will assist in putting to rest some of the inaccurate notions regarding fire setting patterns in the nation.

Fiction - Arson is the fastest growing crime in the United States.

Fact - In terms of both relative and absolute measures, the number of arson cases reported is remaining stable or decreasing slightly.

Moreover, there is some evidence that apprehension rates are on the rise. According to the Federal Bureau of Investigation's Uniform Crime Reporting Program, male and female arrest rates have increased 9 and 31 percent respectively since 1974.

Fiction - It is impossible to prove arson in court, because the fire destroys all evidence.

Fact - Technological advances and increased expertise in crime detection have frequently enabled suspected arson cases to be proven in court. Rarely is all evidence destroyed by fire. In some instances, only minute traces of physical evidence remain, but even these may be detectable by sensitive instruments. Moreover, some evidence simply cannot be destroyed, e.g., motives, financial statements, and witnesses.

It is true that some arson cases can be difficult to prove because the justice process in criminal cases requires proof beyond a reasonable doubt. However, as civil cases require only a preponderance of evidence, where there is insufficient evidence to obtain a criminal conviction, there may be enough to win a civil suit.

The advent of arson reporting immunity legislation in many states will also increase the likelihood of successful conviction of arson offenders by enhancing the capabilities of insurers to share arson-related information with law enforcement officials.

Fiction - Half the fires of unknown origin are actually caused by arson.

Fact - Persistent folklore holds that half of all fires of unknown origin are due to arson—apparently on the theory that arsonists are so competent they set fires which effectively destroy all evidence of arson. Perhaps this theory was adopted for ease of computation—it was easy to divide by two, even before pocket calculators became so common. Also, half of all fires of unknown origin constituted a fairly large number. This, added to known and suspected arsons, made an impressively large total.

There are few studies of fires of unknown origin—because there is little information to work with. One of the most detailed,[30] after considerable study, concluded that arson fires are not noticeably more prevalent in fires of unknown origin than in fires of known cause—about 20 percent or less.

Fiction - Arson cannot be prevented.

[30]Fires of Unknown Origin, Audits and Surveys.

While it is premature to completely dispel this notion, there is increasing evidence that fire service programs can effectively focus on arson prevention. Essentially, this latter view is an outgrowth of research conducted in Boston and New Haven in the mid-1970s which concluded that arson in fact can be prevented when sufficient information is collected. In response, fire services in several locales have established arson information tracking systems; the results have been interesting and, in several instances, encouraging.

SMOKING-RELATED FIRES

THE PROBLEM

Fires caused by the careless use of tobacco smoking materials—principally cigarettes—are a frightening component of the fire problem. These fires cause more deaths than fires due to arson, heating equipment, cooking, or children playing matches. U.S. Fire Administration analysts estimate that in 1983 between 1,400 and 1,500 fire deaths were caused by smoking fires. Virtually all of these involved cigarettes.

HOW SMOKING-RELATED FIRES AFFECT THE U.S. FIRE PROBLEM

Nearly six percent of all structural, mobile property, and outside fires reported in NFIRS were the result of smoking. These fires caused about nine percent of all reported injuries and four percent of the estimated dollar loss. The following table describes smoking fire incidence by absolute and relative measures:

THE SMOKING FIRE PROBLEM, USING ABSOLUTE MEASURES

Category	Reported Fires	Deaths	Injuries	Property Loss
Smoking Incidents	46,818	387	2,223	$ 100,500,000
All NFIRS Incidents	760,939	2,312	25,705	$2,665,200,000

Table 6.11

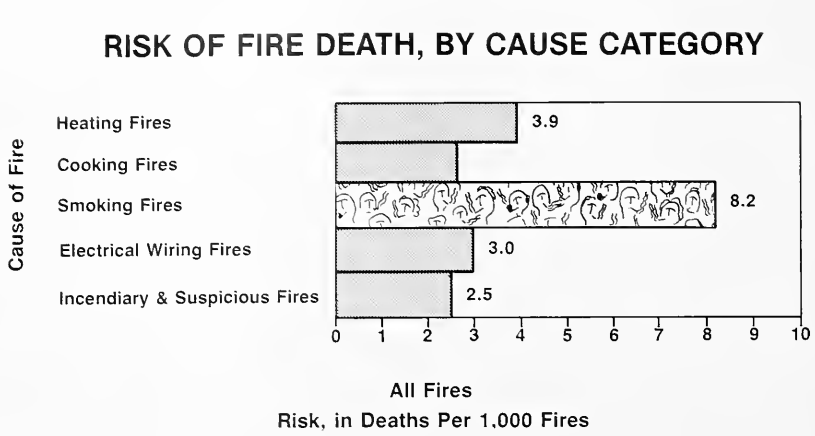
THE SMOKING FIRE PROBLEM, USING RELATIVE MEASURES

Category	Reported Fires	Deaths Per 1,000 Fires	Injuries Per 1,000 Fire	Property Loss Per Fire
Smoking Incidents	46,818	8.3	47.5	$2,200
All NFIRS Incidents	760,939	3.0	34.0	$3,500

Table 6.12

Source: NFIRS Data, 1983
U.S. Fire Administration

The impacts of smoking fires are particularly evident when compared to other categories of fire cause; these are presented in the following figure:

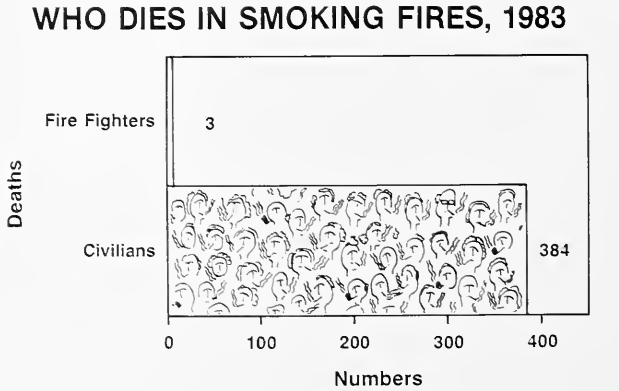


Source: NFIRS Data, 1983
U.S. Fire Administration

Figure 6.2

WHO DIES IN SMOKING-RELATED FIRE DEATHS

Of the 387 smoking fire deaths reported in NFIRS in 1983, almost all were civilians. Only three of the fatalities were fire fighters.



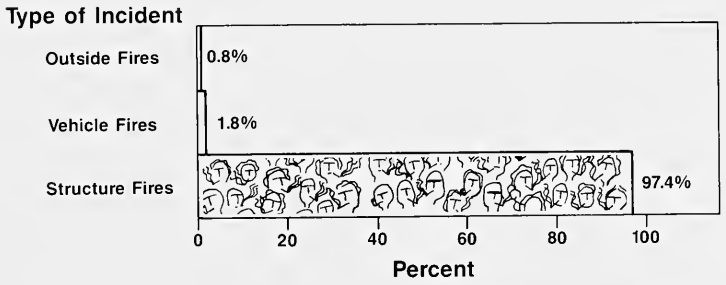
Source: NFIRS Data, 1983
U.S. Fire Administration

Figure 6.3

Smoking is a major factor in multiple death fires; e.g., those fires where three or more deaths occur. Roughly 30 percent of all multiple death fires in 1983 were caused by smoking.

WHERE SMOKING-RELATED FIRE DEATHS OCCUR

SMOKING FIRE DEATHS, BY TYPE OF INCIDENT

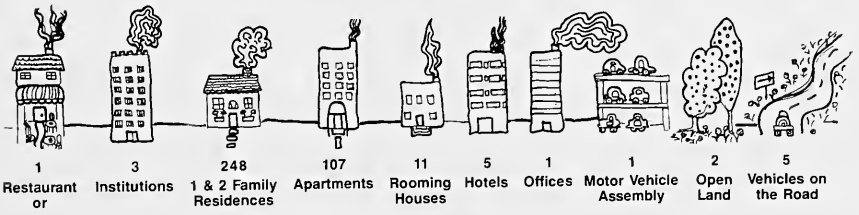


Source: NFIRS Data, 1983
U.S. Fire Administration

Figure 6.4

Typically, smoking fire deaths occur in structural fires. In 1983, nearly all (97.4 percent) of the fire deaths caused by smoking occurred in structures. In turn, the vast majority of these are in residential structures. Figure 6.5 illustrates the location of smoking fire deaths by property use:

WHERE CIVILIAN SMOKING FIRE DEATHS OCCUR, BY PROPERTY USE

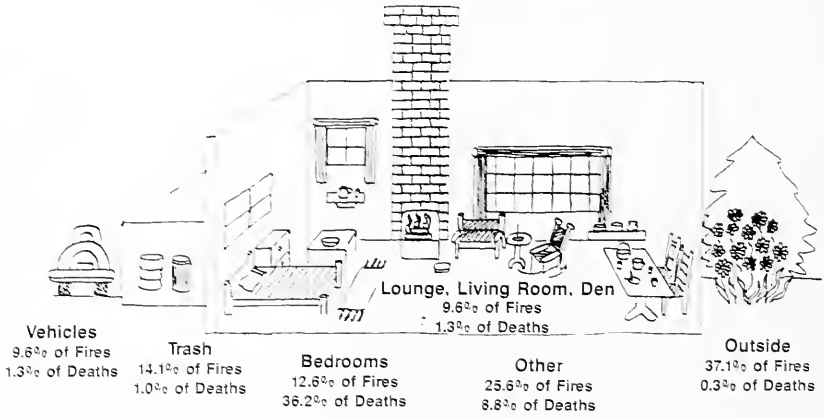


Source: NFIRS Data, 1983
U.S. Fire Administration

Figure 6.5

Figure 6.6 details where smoking fire deaths occur by area of origin:

WHERE SMOKING FIRE DEATHS AND INCIDENTS OCCUR BY AREA OF ORIGIN



Source: NFIRS Data, 1983
U.S. Fire Administration

Figure 6.6

WHEN SMOKING FIRE DEATHS OCCUR

Deaths caused by careless smoking principally take place in the winter and in the early spring. In 1983, 34.5 percent of the deaths reported in NFIRS occurred in December, January, and February; roughly 21 percent took place in March and April.

Figure 6.7 provides further information on the occurrence rate by month:

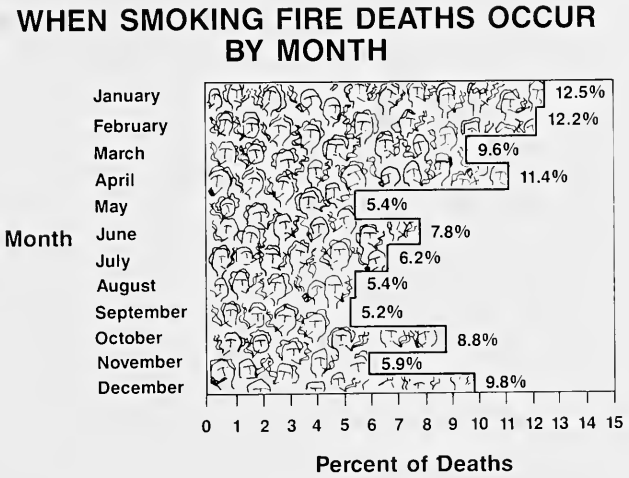


Figure 6.7

Nearly 37 percent of these fire deaths occurred on Saturdays and Sundays. Figure 6.8 details the occurrence rate by day of the week:

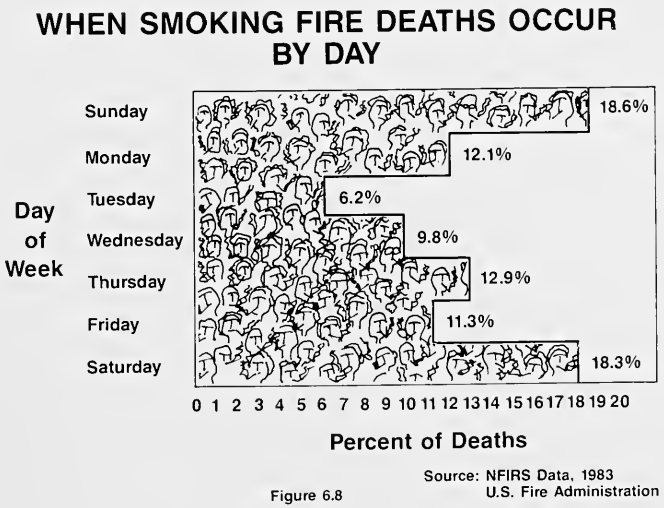
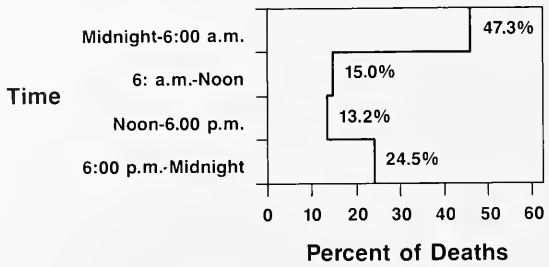


Figure 6.8

By far, the occurrence rate of smoking fire deaths is centered in the late evening hours. In 1983, slightly more than 47 percent of smoking deaths reported in NFIRS occurred between midnight and 6:00 a.m. Figure 6.9 provides additional information:

WHEN SMOKING FIRE DEATHS OCCUR BY TIME OF DAY



Note: Of the smoking fire deaths reported in 1983, 0.2 percent were unaccounted for in terms of the time of occurrence.

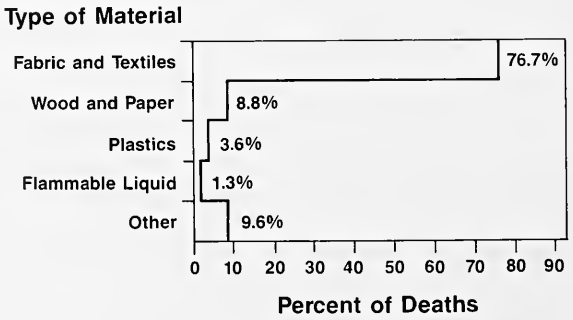
Source: NFIRS Data, 1983
U.S. Fire Administration

Figure 6.9

SINGLE FACTOR ANALYSES OF SMOKING FIRES

Ample lessons can be learned by examining single factors that contribute to the incidence of smoking fires. The following figure outlines the types of material first ignited:

TYPE OF MATERIAL IGNITED IN SMOKING FIRES



Source: NFIRS Data, 1983
U.S. Fire Administration

Figure 6.10

Figure 6.11 illustrates the form of material first ignited in smoking fires:

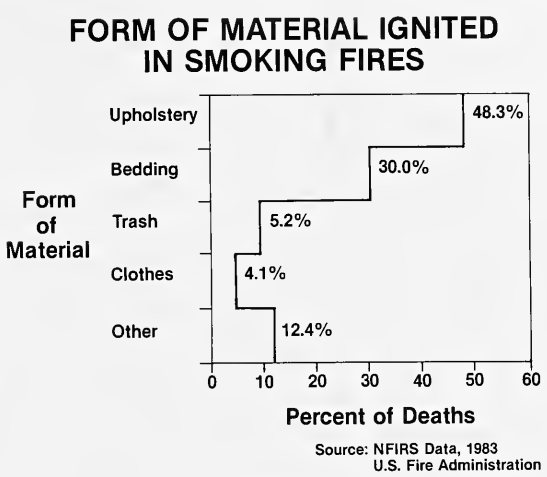


Figure 6.11

CLOTHING FIRES

THE PROBLEM

When a person's clothing catches fire, the consequences can be particularly grave. The probability that the victim will sustain major burn injuries is strong; the likelihood that the victim will not survive these injuries is also high. The problem becomes more troubling with the realization that young children and the elderly are the most common victims of clothing fires. Because of these characteristics, clothing fires have long been a concern of fire authorities.

In the mid-1960s, considerable research was initiated to attempt to find a means of reducing the incidence of clothing fires. Increasingly, research in this area began pointing to the problem of highly flammable fabrics. Analysts maintained that many injuries and deaths were the result of the types of clothing fabric that were worn by fire victims. Certain fabrics were particularly flammable.

WHAT WAS DONE: A LOOK BACK

In response to research findings on clothing flammability, Federal policymakers established the Flammable Fabrics Act (revised and amended December 14, 1967) to prohibit "the introduction or movement in interstate commerce of articles of wearing apparel and fabrics which are so highly flammable as to be dangerous..." Under the mandate of this legislation, the Office of Flammable Fabrics in the Department of Commerce and the Bureau of Products Safety in the Department of Health and Human Services were required to conduct an ongoing review and investigation of the deaths, injuries, and property losses that resulted from the accidental burning of fabric products.

Based on subsequent research conducted by both offices, a new flammability standard concerning children's sleepwear was established in 1971. Fire research, conducted with the use of full scale mannequins in order to replicate real-life settings, revealed that flames tend to spread very quickly over children's garments. Research revealed that between 20 and 30 seconds after ignition, a child's clothing could easily be engulfed in flames. Such findings explained the severe nature of injuries that typically resulted from sleepwear fires. The standard prohibits the manufacture and sale of young children's sleepwear, in sizes 0-6x, unless it is in designated limits of flammability. In 1974, a similar standard was established for older children's sleepwear (sizes 7-14) and was eventually extended to all children's clothing in these sizes.

WHO ARE THE VICTIMS OF CLOTHING FIRES

As mentioned previously, children and the elderly both fall prey to clothing fires. This fact was first documented in 1971 when the National Center for Health Statistics reported that over 1,000 Americans had died when the clothing they were wearing somehow ignited. Of those deaths, 60 percent were among persons 65 years of age and older despite the fact that this same age group constituted only 8.1 percent of the overall population. Similarly, while young children represented only 8.8 percent of the general population, 11.4 percent of the clothing fire deaths were among this age group. While achievements in clothing fire safety clearly have been made within this area in recent years, these groups continue to suffer from disproportionately high numbers of clothing fire deaths.

Blacks also have been found to be in a high risk category—having a clothing fire death rate that is roughly one and one-half times that of Caucasians. It is unclear why this group has such high risks of death from clothing fires. Caucasian children have the lowest rates observed. In turn, minority children show death rates five to ten times those of Caucasian children.

The likelihood of death by clothing fire climbs steadily from middle age. The elderly, and particularly minority elderly, are hit especially hard.

HOW DO CLOTHING FIRES OCCUR

Ignition sources in clothing fires vary according to the age group of victims. Consider sleepwear fires: analysts of accident data compiled by the National Bureau of Standards found that the most common type of sleepwear fire in children between six and twelve years of age took place when girls reached across kitchen range tops while dressed in their sleepwear. In these instances, loose and dangling sleeves acted as a volatile factor in ignition. Other ignition sources among this age group included matches, furnaces, open fires, and candles.

WHAT HAS BEEN DONE TO REDUCE CLOTHING FIRE INCIDENCE

Regulation of children's sleepwear clearly has assisted in the reduction of clothing fires. Statistical data indicate that far fewer children now die as a result of clothing fires.

Fire authorities have continued to seek measures that will effect further improvements in clothing fire safety. New directions in research are also being pursued. Some authorities, for example, question whether additional work on the flammability of wearing apparel may be cost-effective. Several years ago, an effort to establish a standard which would have required tougher flammability rules for adult wearing apparel was met with strong resistance by manufacturing interests. According to the American Apparel Manufacturers Association, the proposed standard would have increased apparel prices 38 percent. Implementation of the standard was postponed until data gathering techniques concerning clothing fire burns could be refined.

New methods of research have also been undertaken. Research regarding safe design of wearing apparel is one such example. Some analysts have found that garments of one style which are made from similar fabric as garments of another style are less likely to come into contact with an ignition source. When the safer designed garments are placed in contact with an ignition source, they tend to burn more slowly. When burn injuries occur while wearing these safer styled garments the extent of injury is less severe. A smaller area of skin is burned, the burn is more shallow, and there is more probability that the victim will take prompt action because the skin will feel warm at the time of the garment's ignition or shortly thereafter. This research has been based on small-scale testing of component fabrics.

Other measures, besides regulation, have also been introduced in the reduction of clothing fire incidence. Fire safety programs, such as "Stop, Drop, and Roll," have increased public awareness about the threat of clothing fires and have educated the public on how to react in the event of a fire.

HOW SEVERE IS THE PROBLEM OF CLOTHING FIRES TODAY

In the past twelve years, clothing fire deaths have declined sharply. In the late 1960s, there were roughly 1,000 such deaths; in 1982 there were 305. Conditions for two of the hardest-hit groups—children and the elderly—have improved immeasurably. Between 1970 and 1980, the number of children under five years of age who died because of clothing fires has been reduced by 90 percent. Such deaths among the elderly have declined by 65 percent.

While the problem has not been completely rectified, members of the fire service, policymakers, educators, and concerned citizens all must take pride in the tremendous achievements that have been realized in this component of the fire problem. The successes in this area demonstrate how preventive programs can reduce fire problems.

MILITARY FIRES

The U.S. Military maintains full membership in the National Fire Incident Reporting System. The Navy and the Marine Corps first joined in 1977; as of 1983, each of the four uniformed services and their civilian components was reporting.

Fire experience in the military service is quite different from civilian jurisdictions. In the military, the fire death rate is approximately ten per million population per year; this

compares to the national rate of twenty-five. Unlike the fire experience of the nation, the most common fire death scenario does not take place in military residences. According to analysts of NFIRS data, there is about one fire per year for every 125 residential housing units in the general population. In military housing, the rate is roughly one in 500.

The statistics are intriguing. A casual observer might fairly assume that military personnel and their families are as prone to such fire-inducing factors as carelessness, smoking, and drinking as other segments of the general population. Nonetheless, the military fire experience seems to be far more successful in fire prevention. Analysts at the U.S. Fire Administration have theorized that the following factors may have contributed to this pattern:

- military housing plans for both barracks and family housing are reviewed for fire safety *before* construction begins;
- smoke detectors are installed in all housing units under military control; heating plant, wiring, and smoke detectors are inspected annually, and maintenance, when necessary, is performed by properly trained personnel;
- base fire departments conduct training in home fire escape techniques;
- portable local heaters—gas and oil-based space heaters—are not allowed in family housing; and
- in barracks and officers' quarters, bedding has been replaced with that made from ignition-resistant materials;

Other factors may also contribute to low military fire rates. When housing fires caused by carelessness of the occupants do occur, all branches of the military routinely collect for damages. According to military authorities, roughly ten percent of the total losses in military housing are recovered this way. To some extent, this practice may also act as a deterrent by encouraging families to adopt careful fire safety measures in their homes.

The intrinsic structure of the military also clearly offers certain control measures in fire safety that are not available to many segments of the general population. For example, because of the hierarchical nature of the military, some pressure can be brought to bear on any individual or family that may be disinclined to maintain their property in accordance fire safety standards. Moreover, given the fact that military personnel tend to be relatively transient—moving from base to base, families are less likely to accumulate needless possessions. Hence, the fire load—meaning the amount of material necessary to burn—in most military households is considerably less than that in many residential properties. Should a fire occur in a military household, it would be less severe and could be extinguished more quickly.

The fire experience of the U.S. Department of Defense exemplifies that fire safety programs can succeed. When the proper amount of planning and implementation occurs, effective fire prevention eventually can be realized. The Department of Defense should be commended for its achievements and should serve as a useful model for the development of similar programs among the civilian population.

chapter 7

programs in fire safety

PROGRAMS IN FIRE SAFETY AND PREVENTION

BACKGROUND

The U.S. fire problem is basically a "human" problem, and its solution will be the result of many people joining together to work toward the reduction of fire in the United States. Alleviation of the fire problem will only come about through the combined and cooperative efforts of:

- U.S. Fire Administration and other Federal programs
- State and local programs; and
- Private sector programs

In recent years, increased public awareness about fire, targeted prevention programs and new technological developments in early warning and fire control systems have aided efforts to reduce the annual losses due to fire. For example, public fire safety education programs such as *Sesame Street*, arson control initiatives, and the increased use of smoke detectors have all contributed to the gains made over the past several years. However, according to Harry J. Walsh, Assistant Administrator, Office of Fire Prevention and Arson Control, U.S. Fire Administration, "It is not enough to point to the reduction in fire deaths and property losses over the last 10 years, and consider the fire safety job done. It is not done. We cannot rest on past achievements. We must do more."

One of the primary missions of the U.S. Fire Administration is to prevent fires. In order to meet this goal, the Fire Administration promotes and sponsors a wide variety of fire prevention and fire safety programs at the Federal, State, and community levels. These efforts include public education campaigns dealing with a wide variety of fire safety and prevention issues, on-going research with regard to technical improvements in fire suppression and fire prevention equipment, and efforts to help ensure that research findings regarding fire safety become reflected, where appropriate, in public policy.

The terms "fire safety" and "fire prevention" mean different things to different people. For the purposes of this report, the term fire safety refers to fire prevention education as well as technical improvements in fire suppression and prevention. Fire safety education has been around for a long time. As early as 1947, Charles Hawkins of the Center for Fire Safety, New York University defined fire education as:

> *. . .a process concerned fundamentally with building knowledge and skills that may be utilized in the removal of circumstances under which uncontrolled and unobserved fires might occur. . . . Fires, both small and large, will occur regardless of the preventative and protective measures that may be taken, and therefore the individual must develop adequate knowledge and sufficient skill to keep at a minimum, possible injury and loss to himself and the community.*

Recognizing that the fire problem must be attacked at the Federal as well as the local levels, the Federal government, particularly the U.S. Fire Administration, has responded in a variety of ways. The U.S. Fire Administration's establishment of the National Fire Incident Reporting System (NFIRS) for the first time provided (and

continues to provide) local fire service managers more comprehensive and accurate data for fire safety planning than was possible even ten years ago. In addition, NFIRS is the first computerized national data base for fire information in the United States and will increasingly inform fire research and prevention efforts across the country.

A number of other Federal agencies participate in the army of fire prevention. The Smokey the Bear campaign, undertaken by the U.S. Forest Service was one of the most effective public education campaigns in history, while the Consumer Products Safety Commission, and the Center for Fire Research (located in the National Bureau of Standards), and the Bureau of Alcohol, Tobacco, and Firearms (Department of the Treasury) also are making major contributions toward the reduction of fire, and improvements in fire fighter health and safety.

What follows are highlights of some of the past and present programs in fire safety undertaken by the U.S. Fire Administration, as well as examples of other state, local and private sector programs attempting to address the fire problem.

The programs described below are in no way intended to be inclusive, rather, they are merely a sampling of the many exemplary programs which exist at the State and local levels. Should the reader seek more information about any of the programs mentioned in this report, or would like to inform the U.S. Fire Administration of your own fire safety efforts, information may be sent, or inquiries made to:

U.S. Fire Administration
National Emergency Training Center
Emmitsburg, MD 21727

FIRE SAFETY PROGRAMS OPERATED BY THE U.S. FIRE ADMINISTRATION

National Fire Incident Reporting System (NFIRS). While not immediately perceived as a fire safety program, the National Fire Incident Reporting System has a commanding role in fire analysis and prevention. (An expanded description of the NFIRS system is provided in the Introduction Section.)

Protocol for Treatment of Fire Victims. The U.S. Fire Administration is working in conjunction with the American College of Emergency Physicians to develop a uniform procedure for diagnosing and treating smoke inhalation. The project will focus on the development of a diagnostic protocol based upon information collected on victims of smoke inhalation, and will include the development of guidelines for what physical signs to look for and how to effectively treat these victims.

Breathing Apparatus Improvements. In conjunction with the Bureau of Mines (U.S. Department of the Interior), Coast Guard (U.S. Dept. of Transportation), and Air Force (U.S. Dept. of Defense), the U.S. Fire Administration is developing an advanced closed circuit breathing apparatus for use by fire fighters. The new apparatus will allow for an extended duration of breathing at such incidents as high-rise fires, tunnel operations, and hazardous materials incidents. Use of this apparatus will allow safer and more efficient operations at the high risk incidents to which fire service personnel must respond.

Protective Clothing Improvements. Under the name Project FIRES, the U.S. Fire Administration is developing a range of advanced protective equipment for structural fire fighting as part of Firefighter Integrated Response Equipment System (FIRES). The project will examine the hazards faced by structural fire fighters, then develop and test equipment (helmet, boots, etc) to provide optimum protection against these hazards.

Fire service personnel will then work with commercial suppliers of fire service equipment to incorporate aspects of the design and materials innovations developed by Project FIRES.

Juvenile Fire Setters. At the 1975 California State Psychological Association Convention in Anaheim, California, a panel of psychologists and fire personnel met to discuss the role of the fire service in interviewing juvenile fire setters. Sixty-five fire service personnel representing 35 different fire departments were in attendance, and indicated that while all of them did some form of interviewing young fire setters, they had received little or no training in interviewing children and their parents.

In response to this need, the U.S. Fire Administration contracted for and produced two landmark manuals dealing with juvenile fire setters—one for children under seven years of age and the other for children between the ages of 7 and 14. The first manual entitled "Interviewing and Counseling Juvenile Firesetters" is designed to teach fire service personnel ways to: recognize problems in children that may lead to fire setting; interview firesetting children and their families; educate curious fire setters and their families about fire safety; identify children and families in needs of professional mental health assistance; and refer them to appropriate community mental health resources. The manual for older juveniles entitled "Juvenile Fire-Setter Handbook: Dealing with Children 7-14" further explains how to identify a serious juvenile fire setting problem and how to establish a structured community program for juvenile fire setters.

To date, the U.S. Fire Administration has sponsored many seminars, and worked with numerous fire departments and community organizations, providing technical assistance and supporting a network of resources to help communities establish an effective juvenile fire setter program.

Arson Reduction Programs. The U.S. Fire Administration, continuing its leading role in attacking the arson problem through a broad range of anti-arson efforts, developed the Arson Information Management System (AIMS) and the Arson Resource Center. These services are available to local communities to help them combat their local arson problems. The AIMS program is a computer-based system designed to collect, organize and analyze the information necessary in the evaluation and management of on-going incendiary crime detection, prediction and prevention efforts. The Arson Information Management System is a package of utility and data analysis programs designed to provide state-of-the-art capabilities of computer-assisted operation to an arson task force. The system is divided into reactive strategies and proactive strategies. Reactive strategies consist of timely investigative management decision rules, while proactive analyses are used to predict arson-prone subjects, buildings or situations.

A number of successful AIMS projects have been funded at demonstration sites throughout the United States including Knoxville, Tennessee, where the AIMS Computer system was used in preparation for the 1982 World's Fair. Prior, during, and after the World's Fair, AIMS analyses of arson data were instrumental in identifying high risk geographic areas. Selective code enforcement programs and other anti-arson strategies were concentrated in these areas, resulting in substantial reductions in both arson caseloads and direct property losses. Since the close of the World's Fair, Knoxville's arson caseloads have dropped 20 percent, while direct property losses, resulting from intentionally set fires, have decreased 81 percent.

The Arson Resource Center, located in Emmitsburg, Maryland, offers a comprehensive arson reference information service. The center will provide up to ten articles or sources of information per request on topics related to arson prevention and control.

Woodstove Safety. The U.S. Fire Administration has also sponsored efforts to encourage the safe use of wood fuel stoves. A small pamphlet entitled "Warm up to Wood Safely" gives basic fire safety tips, and more intensive and extensive public education programs have also been designed for delivery through mass media. Materials have also been developed for distribution in a house-to-house, direct contact type of campaign.

Children's Television Workshop. In 1979, accidental deaths by fire among pre-school children had reached an alarming rate. Although children under age five comprised only seven percent of the total U.S. population, this small group accounted for 17 percent of all fire deaths. With this alarming statistic in mind the U.S. Fire Administration commissioned a study to evaluate the efficacy of fire education for pre-schoolers.

This project was undertaken by the Community Education Services Division of the Children's Television Workshop (CTW)—creators of *Sesame Street*. Their research concluded that while some fire safety lessons were appropriate for television viewing, the bulk of the material needed to be demonstrated on an adult-to-child basis. The Fire Administration then commissioned CTW's Community Education Division to design materials and an approach to teach pre-schoolers about fire safety. After refining the materials and approaches, the program was nationally funded, and *Sesame Street* began to emphasize fire safety, using their research findings in the development of messages that focused on three main topics: understanding fire and burns, learning about smoke detectors, and getting to know the fire fighters. Each season, new segments on various aspects of fire safety will be added to *Sesame Street*.

Automatic Sprinkler Systems and Smoke Detectors: Dedicated to reducing the staggering loss of life and property caused by fire, the U.S. Fire Administration this year produced "An Ounce of Prevention" a 16-page booklet focusing on the fire and life safety protection offered by automatic sprinkler systems and smoke detectors. Funded by the American Textiles Manufacturers Institute, the Carpet and Rug Institute, the Man-Made Fiber Producers Association, and the Society of the Plastics Industry, publication of the booklet represents an excellent example of government/industry cooperation. In addition, the Fire Administration has joined private industry and the fire service to advance the development of residential sprinklers. Since 1976, the U.S. Fire Administration has promoted studies, research, development and testing of residential sprinkler systems.

Emergency Education Network. In 1981, the U.S. Fire Administration developed EENET—The Emergency Education Network. This system was used the first time in 1981 to meet the specific training needs of the Alaska State Fire Marshal. Familiar with the public fire safety education material developed by USFA and the Children's Television Workshop for the Sesame Street television program, the Fire Marshal requested Fire Administration personnel go to Alaska and travel throughout the state, providing the same fire safety information in a "train the trainer" format. Because of the vastness of Alaska, traveling from place to place was estimated to be cost prohibitive, so USFA decided to experiment with the idea of videoconferencing the fire safety information requested by Alaska's Fire Marshal.

Alaska's satellite network donated the necessary satellite time to transmit a two-hour program. The U.S. Fire Administration then took the content experts to a television studio in Juneau, Alaska, and the program was broadcast to approximately 200 "receive" sites where viewers had been provided packages of training materials.

By popular request, the program was rebroadcast three times, the estimated audience of 75,000 trained at a cost of only $0.12 per participant.

The approach was used a second time in 1982 when the USFA used videoconferencing to deliver a series of workshops nationwide on hazardous materials. The workshops were televised to sites across the country and combined local training efforts.

As EENET grew, its internal management evolved. Initially a project of the U.S. Fire Administration, FEMA's Office of Information Resources Management assumed management of the leased and owned communications facilities. This move has allowed the USFA to focus on content development, television production and audience building. The users of EENET are the other divisions of FEMA—National Fire Academy, Emergency Management Institute, and State and Local Programs (SLPS).

Fire Investigations Program: The U.S. Fire Administration is a joint participant in a cooperative agreement between the National Fire Protection Association (NFPA) and the Center for Fire Research to undertake a series of in-depth fire investigations. This cooperative relationship, begun in 1973, has been responsible for the investigation of many major fires. The program is intended to provide accurate information on major fires, so that lessons learned from these fires can be widely applied in the field. Investigation criteria includes:

- fires killing three or more fire fighters;
- multiple death structure fires;
- incidents requiring EMS mobilization;
- fires causing $10,000,000 or more in property loss;
- fatal fires in mass transit; and
- other fires not meeting the above criteria but with important lessons for the fire service.

The criteria defined above serves as a focus for fire investigations undertaken under this cooperative agreement; however not all fires meeting these criteria are investigated. During 1983, fourteen fires were investigated under the cooperative agreement including: a fire occurring on an in-flight DC-9, which resulted in the deaths of 23 people; a hotel fire in Dayton, Ohio in which the presence of fire containment characteristics such as retrofit doors and door closers prevented the fire from entering guests' rooms; and a fire in a boarding house in Worcester, Massachusetts where seven deaths occurred because of a series of combined factors including an open stairway, combustible interior finish, and the lack of early detection and warning devices. A full list of these investigations is shown in Appendix C. The reports themselves may be read at the National Emergency Training Center (NETC) in Emmitsburg, Maryland.

OTHER FEMA FIRE SAFETY PROGRAMS

Learning Resource Center. Also located in Emmitsburg, Maryland, the Learning Resource Center (LRC) is the knowledge repository of the Training and Fire Programs Directorate of FEMA, and the on-campus library and audio/visual center for NETC students and staff. It houses the largest collection of fire-fighting and emergency management literature in the Nation. Included among the more than over 50,000 books, reports and periodicals, are two specialized collections and related services—the Emergency Management Information Center (EMIC) and the Arson Resource Center.

The EMIC is a collection of significant case studies of recent major disasters. Each includes all or some of the following materials; videotapes, research reports, slides, after-action reports, photographs, books and magazine articles. FEMA personnel and state level emergency management officials may borrow EMIC case studies. All case studies are available for loan only. State level requests must be submitted in writing to EMIC.

The Arson Resource Center provides reference services to any individual with a question on arson. The reply may include a bibliography and other brief documentation. The Arson Resource Center is the distribution center for the U.S. Fire Administration's arson-related publications. No materials are offered through the center.

National Fire Academy. The National Fire Academy serves as the national focal point for fire education and training to advance the professional development of fire service personnel and others engaged in fire prevention and control activities. Academy activities revolve around seven program training areas:

Executive Fire Officer - designed to provide senior officers an opportunity to continue their professional development over a three-year period. Graduates of this program are then eligible to compete for FEMA Fire Executive Fellowships (in cooperation with Harvard University's Kennedy School of Government).

Command and Staff - designed to provide a coordinated, highly intensified approach to mid-level fire officer training.

Fire Service Technical Specialist - designed to provide specialized training of operational and technical skills, including hazardous materials, arson mitigation, fire prevention inspection/enforcement, management information, fire safety education, and fire training.

Line Officer (Train the Trainer) - a "master plan" has been implemented to address the "weak link" of fire service training—the line officer—by directing the efforts of the Academy to help develop the skills and abilities of these officers.

Direct Supplementary Delivery - designed to supplement State and local training efforts with state-of-the-art training in subjects that address emerging technologies and needs of fire service organizations.

Special Programs - designed to provide a dynamic interface with the fire service and allied professions. This program provides workshops, seminars, conferences, technical assistance and training assistance to State and local fire service organizations.

Open Learning for the Fire Service Program (OLFSP) - designed to provide a program that gives fire service personnel an opportunity to earn Baccalaureate Degrees in Fire Administration and Technology.

OTHER FEDERAL FIRE SAFETY PROGRAMS

The Center for Fire Research

Under the auspices of the National Bureau of Standards, the Center for Fire Research (CFR) is directly engaged in a broad program of research in all aspects of fire safety and fire problems. Current CFR programs include the development of practical engineering methods for fire safety design, and the development of research models to

predict smoke movement in buildings. In addition, efforts are underway to identify and measure potentially harmful combustion products and to quantify their effects on living organisms as well as to develop quantitative measures of the ignitability and fire contribution of furnishings for use in modeling of fires and for providing guidance to manufacturers regarding improved fire behavior.

The application of the findings from CFR research to the world around us should contribute to a more fire safe environment. With daily introduction of more and more synthetic products, whose behavior under fire conditions is virtually unknown, research of the quality conducted at CFR becomes an increasingly essential ingredient in our efforts to reduce the toll in terms of life and property loss that is exacted by fire.

Consumer Product Safety Commission

The Consumer Product Safety Commission is an independent Federal regulatory agency established by the Consumer Product Safety Act, October, 1972. The Commission is charged with identifying and making safe products for sale in general commerce. The Consumer Product Safety Commission uses NFIRS data plus its own National Electronic Injury Surveillance System (NEISS) to obtain information on products which causes injuries. NEISS is based on reporting by hospital emergency rooms.

The Consumer Product Safety Commission has carried out numerous field investigations of allegedly injurious products. It then usually works directly with the manufacturers to make the product safe. For example, the Consumer Product Safety Commission, in cooperation with Electro Signal Laboratory Inc. of Rockland, Massachusetts, affected a voluntary recall of approximately 500,000 of its smoke alarms, when it was found that some might not sound or might fail to sound loudly when smoke was present. An outright ban of a dangerous product is used only as a last resort. Currently, the Commission has also developed and put into operation 29 fire safety projects. These include alternative heaters, flue pipes, and cooking appliances among others.

Division of Cooperative Forest Fire Control

The U.S. Forest Service through its Division of Cooperative Forest Fire Control, coordinates the activities of Federal, State and private landowners. As an outgrowth of the Clark McNary Act of 1923, the U.S. Forest Service undertook the coordination of agency resources to be devoted to the protection of certain types of land. The Federal agencies involved include: Bureau of Land Management, Bureau of Indian Affairs, Bureau of Reclamation, National Park Service, and the Tennessee Valley Authority. All fifty states participate in the program as do many private landowners.

In 1980, the last year for which data was available, the total area protected by the Federal Government was 1,486,188 acres, about 89 percent of the total land which qualified for protection under Clark McNary. There were 155,659 fires on this land which burned over 3,098,832 acres—about .2 percent of the protected land. The average area burned was 20 acres. For unprotected land, fires burned about 30 acres per fire, although reporting is incomplete for the unprotected lands.

Bureau of Alcohol, Tobacco and Firearms

The Bureau of Alcohol, Tobacco and Firearms (U.S. Department of the Treasury), has been charged with investigating fires believed to be incendiary as well as any cases of bombing, fire bombing or use of an incendiary device. While not compelled to investigate every fire deemed incendiary, the Bureau is often called in to assist in investigations—as

the Bureau possesses extensive laboratory equipment for performing detailed analyses which would be unavailable in many fire service jurisdictions.

STATE LEVEL FIRE SAFETY PROGRAMS

The U.S. Fire Administration has sponsored a number of State fire safety programs, and whenever possible encourages and promotes the development of innovative fire safety programs. In addition, many states have, on their own, developed innovative fire safety programs designed to address specific fire problems in their states.

Fire Prevention Contest. The Illinois Office of the State Fire Marshal designed and implemented its first annual Fire Prevention Contest. Contest participation was open to all fire departments in the State of Illinois. A total of 39 departments participated, and winners were chosen on the basis of a review of their year-long fire prevention efforts. The wide variety of entries submitted provided an indication of the inventiveness of the State's approach, and the ingenuity of participating fire departments.

Smoke Detector Program for Preschoolers. Responding to concerns that many young children were extremely frightened of the noise made by smoke detectors—and knowing this fear could result in inappropriate responses to emergency situations—the **Georgia Fire Academy** undertook a program to familiarize children with smoke detectors. The program includes fire service personnel going into the schools to familiarize children with smoke detectors, emphasizing that a smoke detector is like a "friend" who is there (on the ceiling) to sniff the air for smoke. Children are told that when the alarm goes off, the smoke detector "friend" is telling the child, by way of a special sound, that something is burning; and rather than being frightened and panicking or hiding, the child should calmly listen and respond appropriately to the message being given by the detector.

COMMUNITY-BASED FIRE SAFETY PROGRAMS

Because the fire problem is basically a community problem, local efforts must include the ingenuity and resources of local governments, fire service personnel and private industry. While Federal and State programs can address broad-based issues, such as the promotion of smoke detectors and automatic sprinklers, local needs must be identified and responded to by local communities, with encouragement from the U. S. Fire Administration.

Fire Education and the News. Developed by the **Santa Monica, California, Fire Department** and funded by the U.S. Fire Administration, "Fire Education and The News" program was developed, responding to documented evidence that television news is now the primary source of information and education for a majority of America's population. Based upon this finding, the Santa Monica Fire Department sought to use local television news programs as a vehicle for delivering fire safety messages. In 1980 the first such television segment was put together. The format was a five part series called "It Can Happen To You." The series was seen by an estimated seven million viewers.

A novel approach to the reduction of residential fire death was taken by the **Philadelphia Fire Department.** Focused around a pamphlet prepared by the Fire Prevention Division entitled "A Fire Death Has Occurred in Your Neighborhood," the program involved personnel from both the Fire Prevention Division and the local fire company doing fire prevention work, on foot, in neighborhoods where fire deaths had occurred.

A two-block area was mapped out in each direction from the site of the fire death, and fire personnel attempted to personally contact and provide safety information to each person in this grid. Information was provided on the actual death, what might have prevented that particular death, general fire safety, and the promotion of smoke detectors and escape planning. A follow-up visit was done approximately one month later to reinforce fire safety messages. To date, evidence shows that 60 percent of those contacted took some form of fire prevention action, from cleaning up an area, thereby reducing the amount of combustible material present, to the purchase and installation of a smoke detector.

In **Houston, Texas,** a **Cease Fire Club** was established to help address the problem of juvenile fire setters. A blue ribbon committee of some of Houston's most prominent people took on the task of fundraising for a program designed to help juvenile fire setters. The program, consisting of recreational components, field trips, and counseling for juveniles and their families is available to any child in Houston who is considered to have demonstrated an abnormal interest in fires. Many children are referred to the program by the courts, schools, or fire department personnel, families who believe their child may be manifesting an inordinate interest in fire may also ask that their child be admitted to the program.

To date, the Cease Fire Club has raised sufficient funds to provide a full-time staff, including psychologists, and have secured the donation of a building.

In an attempt to make **Louisville, Kentucky's** school children aware of fire safety, and to increase public attention regarding fire safety in general, the **Great Louisville Fire Drill** was established. The program involves a fire facts contest, which takes place among school-age children from over 360 public schools in Louisville. In each school a contest is run for children grades K-4.

Children are provided a list of fire facts and a postage-paid postcard. Each child is then asked to transfer one "fire fact" to a postcard, their own name and school also indicated. An event called the Great Louisville Fire Drill is then held in a local park, and fire apparatus, and each child's postcard is attached to a helium filled balloon. The balloons, with their attached fire safety messages are then released. The balloon messages include a self-addressed, paid-postage, return post-card, with a request to ask people who find the balloons to return the postcards. Within a week, thousands of return postcards have been received, and it can be determined which child's balloon went the farthest. A winner is declared and made "chief for a day". Thousands of fire safety messages are sent out each year through this contest, fire messages traveling as far as 350 miles away.

PRIVATE SECTOR FIRE SAFETY PROGRAMS

Learn Not to Burn. The National Fire Protection Association (NFPA) of Quincy, Massachusetts is a private non-profit organization dedicated to fire safety. Over the past 90 years, NFPA has collected technical information on fires, and done pioneering work on the development of model codes and standards for attaining minimum levels of fire safety, and designed and disseminated fire prevention education programs. Among their innovative education programs is the Learn Not to Burn program. The main component of the program is its curriculum, which presents 25 key fire safety behaviors. Adopted and presented on a school-by-school basis, the curriculum incorporates visuals including subject cards, films, slides, pamphlets, books and posters.

To ensure that the messages are reinforced throughout the elementary school years, the curriculum is developed on three levels: kindergarten through second grade, third through fifth, and sixth through eighth. One of the key features of the curriculum is the inclusion of lesson plans that allow a teacher to integrate fire safety lessons with traditional classroom subjects. To date, the Learn Not To Burn program has been documented as having saved the lives of over 131 children.

Junior Fire Marshals Program. In 1947, the Hartford Insurance Group introduced their Junior Fire Marshal program, sometimes regarded as the first nationally distributed fire safety program for children. The program—involving more than 1,300 insurance agents in all 50 states who serve as Junior Fire Marshal sponsors—provides education materials to schools and includes a "Four Steps to Safety" multi-media kit which makes it easy for schools to teach fire safety to children.

Children from kindergarten through third grade receive lessons in basic fire prevention and fire safety through the program. Four lessons are emphasized: don't play with matches; practice home fire safety drills with your family; crawl under smoke to escape a burning building; and stop, drop and roll to extinguish burning clothing. Also, Junior Fire Marshall awards and medals are bestowed upon youngsters who display brave, quick and correct action during a fire.

Make Time for Fire Safety: Sponsored by the Burger King Corporation, this program is designed for children grades K-6, and includes a curriculum unit entitled "Make Time for Fire Safety." It includes flash cards, duplicating masters, drawing and coloring projects, and a teachers guide.

Also available through the Burger King program are Snuffy the Talking Fire Engine (for use in schools, mall exhibits, and parades); a 15-minute film entitled *Snuffy's Fire Brigade;* and the Hot Spot House—a four foot high, three-dimensional house highlighting fire safety hazards in the home.

FIRE SAFETY TIPS

Specific measures can be employed to reduce the risk of major property loss in your home and business. To protect your home:

1. Provide for early detection. Smoke detectors will alert you in the initial stages of a fire.

2. Have regular inspections and maintenance of wiring, appliances, heaters, and chimneys.

3. Throw out unnecessary combustibles. Additional combustibles mean a longer burning, hotter fire—and more loss.

4. Where possible, install solid core doors between different rooms in your home and business. "Rated" doors will contain a fire for several minutes—providing valuable, added time for you to exit safely and for the fire department to extinguish the fire. Remember, however, doors must be closed to work.

5. Install a residential sprinkler system. While it is an expensive measure, one single, serious fire will cost you far more in property loss.

6. Check your insurance policy. Make sure it covers all your property and all your needs.

7. Keep special and valuable keepsakes in a secure place—like a safety deposit box. Contact your insurance agent about these items; they may require a special clause in your policy to be covered by your insurance.

To reduce potential fire loss in your business:

1. Select a business location with an adequate water supply for firefighting and convenient access for firefighting in various parts of the building.

2. Divide your business quarters into distinct fire areas. Huge losses occur when a fire can sweep unobstructed through open spaces. There are even recorded instances of fires extending to remote parts of buildings by "riding" on conveyor belts through holes in fire walls.

3. Avoid stylish but combustible construction. Wood shingle roofs, while attractive, have been central in many large-loss fires.

4. Provide for effective fire detection and reporting. Security service also may be advisable. Alarms and fire sensors are of limited value if there is no one to hear and call the fire department.

5. Select the correct type of automatic sprinkler system for your facility. Automatic sprinklers are a tested means of arresting most fires while they are still small.

6. Keep your sprinkler system properly maintained and your water valve turned on at all times.

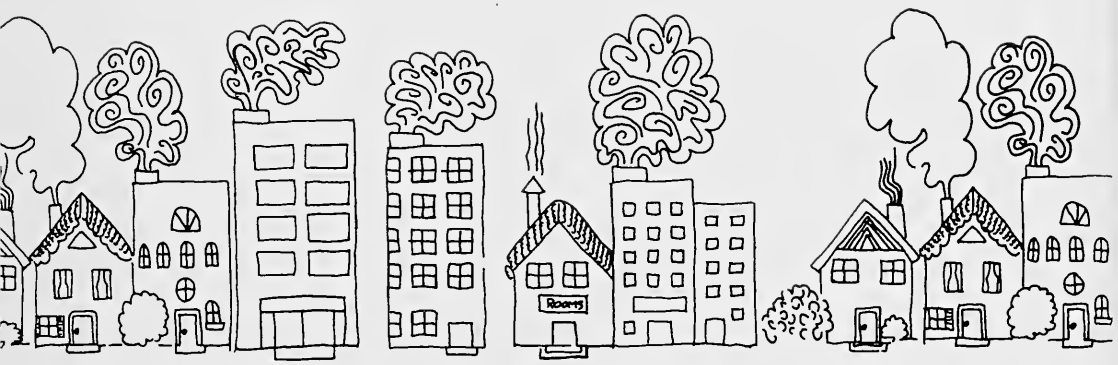
7. Check your insurance policy to make certain you have sufficient coverage to provide good protection against major loss. By increasing the amount of your deductible, for example, you can obtain higher coverage at no extra cost.

8. Obtain extra protection for items of special value—a computer, an object of art, a priceless formula. If it is *that* valuable, it is well worth the cost of coverage.

9. Divide your stock in at least two locations. If a fire destroys your primary supply, you will be left with an adequate supply of stock which to conduct business.
10. Protect your records. If you do have a fire, you will want all your accounts receivable to be in good order so that you can be fairly reimbursed for your losses.

chapter 8

regional analysis of 1983 fire activity



REGIONAL ANALYSES OF U.S. FIRE ACTIVITY

INTRODUCTION

This year's edition of *Fire in the United States* marks a special turning point. For the first time since the inception of the National Fire Incident Reporting System (NFIRS), detailed analyses of fire activities in four regions of the nation have been undertaken and are presented in this report. Each analysis is followed by state by state descriptions of 1983 fire experience based on NFIRS data. We believe that these analyses will help to provide readers a more accurate understanding of critical patterns of fire incidence in America.

While far from perfect, these analyses signify an important sign of progress and maturity for the National Fire Incident Reporting System. This year's analyses are based on a total of 767,310 incidents. (Information concerning the number of state fire departments is based on the results of a 1981 survey of state-level fire training systems conducted by the National Emergency Management Training Center.) The NFIRS data base is now of sufficient size and detail to examine a full range of issues. In the coming years, we hope to provide increasingly tailored views of regional fire records. By so doing, fire programs can become more finely honed to meet specific problems and challenges.

To a very large extent, the continued growth and development of these regional analyses depends on the contributions of NFIRS participants. Progress can only be realized by accurate and rigorous reporting by departments. We hope that the regional analyses will be the impetus necessary to encourage those departments that have neglected to participate in NFIRS in prior years. Our thanks to the many departments that contributed to this year's achievement.

FIRE ACTIVITY IN REGION I

The diverse states of Connecticut, Maryland, Massachusetts, New Jersey, New York, Rhode Island, Vermont, and Washington, D.C. all constitute Region I of the National Fire Incident Reporting System. Delaware and New Hampshire, although NFIRS participants, did not submit data in 1983 and, so, are excluded from this regional analysis. Pennsylvania and Maine did not participate in NFIRS and, hence, are not included in the analysis.

In 1983, fire departments throughout Region I reported the occurrence of 151,134 total incidents. This fact raises an important point concerning the general content of our analysis. Not all fire departments in the region participated in NFIRS during 1983. Because of this, there are elements of uncertainty in the accuracy of the findings in this regional analysis. For example, only 21.1 percent of the fire departments in New Jersey submitted NFIRS reports in contrast to Rhode Island, where nearly 94 percent of the departments were NFIRS participants. Data from these two states have different levels of completeness. In other words, the data bases of all states are not fully representational and readers of this report are cautioned to bear this in mind in their review.

As in other regions, structure fires formed the core of the fire problem and were the most common situation found by regional fire fighters. Based on NFIRS reports, structure fires—which represented 36.2 percent of all incidents in Region I—took place slightly more frequently than in the nation as a whole (35.8 percent). In turn, the incidence of deaths reported from Region I structure fires (87.7 percent) was higher than any of the other fire regions and of the nation as a whole (77.6 percent). Another critical ingredient of the fire problem—vehicle fires—were reported at a slightly lower rate of incidence in Region I (22.7 percent) compared to the national average (24.6 percent). The death rate from Region I vehicle fires (11.0 percent) was lower than that of the nation (19.0 percent). A comparative listing of fire situations found in Region I states is presented in Table 8.1.

An examination of fire incidence by category of fixed property use, presented in Table 8.2, provides further insights into the 1983 experience of Region I. In most states, special property fires—while generally less severe in terms of casualties—outnumber incidents in other categories of property use. Based on national averages, for example, 46.9 percent of all incidents reported involved special property fires. To some extent, Region I departed from this trend. In Region I, fires (30.1 percent) barely outnumbered residential fires (29.4 percent). Deaths reported from residential property fires (82.4 percent) in Region I were higher than the national average (72.6 percent). However, there was a lower incidence of deaths occurring from special property fires (8.4 percent) in Region I in contrast to the national record (19.1 percent).

ELEMENTS OF FIRE INCIDENCE

A better understanding of fire activity in Region I can be achieved by using NFIRS data to examine three major causal elements of the fire problem: the equipment involved in a fire's ignition; the form of material first ignited; and the ignition factor. Table 8.3 summarizes findings pertaining to these factors and is followed by a brief, descriptive overview. A detailed discussion of causal elements of fire incidence on a state by state basis is provided in subsequent sections of this regional analysis.

FIRE INCIDENCE IN REGION I BY SITUATION FOUND

State	*NFIRS* Fires	*NFIRS* Deaths	*Structure Fires* Fires%	Deaths%	*Vehicle Fires* Fires%	Deaths%	*Trees, Grass Brush Fires* Fires%	Deaths%	*Refuse Fires* Fires%	Deaths%	*Other*[a] Fires%	Deaths%
Connecticut	23,510	57	31.5	96.5	21.5	3.5	25.8	—	18.1	—	3.0	—
Maryland	21,074	56	41.6	89.3	23.8	8.9	22.2	—	9.7	—	2.7	1.8
Massachusetts	22,670	66	31.5	90.1	39.7	7.8	7.9	—	19.0	—	1.8	—
New Jersey	10,318	7	23.8	71.4	19.1	28.6	36.0	—	16.7	—	4.2	—
New York	55,624	144	39.6	80.5	18.6	18.1	20.7	.7	16.0	—	5.6	—
Rhode Island	7,903	11	23.2	81.8	15.5	18.2	38.7	—	19.4	—	2.7	--
Vermont	4,152	29	67.6	96.6	11.3	—	12.7	3.4	5.7	.3	2.6	.3
Washington, D.C.	5,883	11	39.4	100.0	21.4	—	8.0	—	27.2	—	3.6	—
Region I Total	151,134	381	36.2	87.7	22.7	11.0	21.0	.53	16.3	.26	3.8	.53
U.S. Total	767,310	2,298	35.8	77.6	24.6	19.0	19.9	.9	15.8	.3	3.8	2.2

[a]"Other" includes incidents found outside of structures, explosions, outside spills and leaks, and miscellaneous fires.

Table 8.1

FIRE INCIDENCE IN REGION I BY FIXED PROPERTY USE

State	NFIRS Fires	NFIRS Deaths	Public, Institutional Educational Property Fires%	Public, Institutional Educational Property Deaths%	Residential Property Fires%	Residential Property Deaths%	Commercial, Office Industrial Property Fires%	Commercial, Office Industrial Property Deaths%	Special Property Fires%	Special Property Deaths%	Unclassified Fires%	Unclassified Deaths%
Connecticut	23,510	57	4.6	—	28.3	94.7	8.0	1.8	50.3	3.5	8.8	—
Maryland	21,074	56	2.9	1.8	37.4	87.5	5.7	3.6	36.3	3.6	17.3	3.6
Massachusetts	22,670	66	3.8	—	23.0	90.9	6.9	1.5	28.8	6.0	37.6	1.5
New Jersey	10,318	7	3.1	—	16.6	71.4	13.9	—	37.0	14.3	29.4	14.3
New York	55,624	144	2.9	.3	30.9	71.5	7.6	7.6	15.0	13.2	43.7	6.9
Rhode Island	7,903	11	3.5	—	18.0	45.4	6.7	18.2	64.4	27.3	7.4	9.1
Vermont	4,152	29	3.0	—	60.0	93.1	3.4	10.4	3.4	7.4	9.1	—
Washington, D.C.	5,883	11	5.3	—	32.9	100.0	6.4	—	29.9	—	25.5	—
Region I Total	151,134	381	3.5	.53	29.4	82.4	7.7	4.7	30.1	8.4	29.4	3.9
U.S. Total	767,310	2,298	3.7	1.4	30.3	72.6	9.7	4.6	46.9	19.1	9.3	2.2

Table 8.2

CAUSAL FACTORS OF REGION I FIRES

Equipment Involved in Ignition	**Fires**	**Deaths**
—Heating Systems	11.6%	13.7%
—Cooking Equipment	4.2%	4.1%
—Electrical Distribution	4.8%	6.4%
—Other Remaining Categories of Equipment	7.6%	16.9%
—No Equipment/Vehicle/Non-Standard Equipment	31.3%	36.0%
—Unknown/Blank/Invalid	40.5%	22.9%
Totals	100.0%	100.0%

Form of Material Involved in Ignition	**Fires**	**Deaths**
—Structural Framework	8.8%	25.2%
—Power Transformation	12.7%	9.6%
—General Form	23.3%	2.5%
—Furniture/Soft Goods/Apparel	8.9%	36.0%
—Other Remaining Categories	14.9%	12.1%
—Unknown/Blank/Invalid	31.4%	14.6%
Totals	100.0%	100.0%

Ignition Factor	**Fires**	**Deaths**
—Misuse of Heat	8.8%	27.7%
—Mechanical Failure	18.0%	12.7%
—Operational Deficiency	9.5%	11.8%
—Misuse of Material	4.3%	6.1%
—Arson (Incendiary, Suspicious)	16.3%	11.5%
—Other remaining categories	6.9%	8.5%
—Unknown/Blank/Invalid	36.3%	21.7%
Totals	100.0%	100.0%

Table 8.3

SUMMARY

The fire experience of Region I can be explained, in part, by its geographic make-up. Barring several exceptions, the states that make up this region have large urban concentrations where structural fires—particularly in residential properties—can easily occur when individual strategies for prevention are not routinely practiced. In turn, the buildings in many of these eastern locales were built years in advance of modern fire codes. Such antiquated structures can pose serious fire safety risks. A higher proportion of deaths and injuries can be anticipated when severe fires involve these structures.

Certain causal elements—such as fires ignited by heating systems—might be expected to have higher incidence rates in the colder climates found in these eastern states. These points are further illustrated in the following state-by-state treatments of regional fire activity.

CONNECTICUT

Nearly three-fourths (70.0 percent) of the 309 fire departments in Connecticut participated in NFIRS in 1983. The U.S. Fire Administration commends these departments for their high level of participation and general support of NFIRS. During this period, departments reported 23,510 incidents from which 56 civilians and one fire fighter died. As Table 8.1 indicates, Connecticut's 1983 fire problem was concentrated in several key areas: structure fires (31.5 percent of all state NFIRS incidents), outdoor fires (25.8 percent), and vehicle fires (21.5 percent). In 1983, more than three-fourths of the state's fires took place in these three categories.

A look at fire occurrence by fixed property use (See Table 8.2) reveals that incidents in Connecticut most frequently involved special property (e.g., outdoor and roadways), which constituted 50.3 percent of all fires, and residential property, which represented 28.3 percent of all incidents. Throughout the nation, residential fires generally posed the most severe threat to public safety. In Connecticut, during 1983, 94.7 percent of all NFIRS-reported fire deaths were directly attributable to incidents involving residential property. Connecticut's residential fire death ranking was considerably higher than averages for the region (82.4 percent) and for the nation (72.6 percent).

ELEMENTS OF FIRE INCIDENCE

A more complete picture of fire activity in Connecticut can be achieved by using NFIRS data to examine three major causal elements of fire incidence: the equipment involved in ignition of a fire; the form of material first ignited; and the ignition factor.

Findings pertaining to these elements are summarized in Table Connecticut-1 and a brief descriptive overview follows.

TABLE CONNECTICUT-1

CAUSAL FACTORS OF CONNECTICUT FIRES

Equipment Involved in Ignition {1}	**Fires**	**Deaths**
—Heating Systems	8.0%	5.3%
—Cooking Equipment	5.4%	12.3%
—Electrical Distribution Equip't.	3.7%	8.8%
—Other/No Equipment	58.0%	61.4%
Form of Material Ignited {2}	**Fires**	**Deaths**
—Structural Framework	6.0%	14.0%
—Power Transformation	15.2%	0.0
—General Form (Grass/Trash)	46.9%	14.0%
—Furniture/Soft Goods/Apparel	9.7%	52.6%
Ignition Factor {3}	**Fires**	**Deaths**
—Misuse of Heat	16.1%	42.1%
—Mechanical Failure	18.7%	10.5%
—Operational Deficiency	6.1%	5.3%
—Arson (Incendiary, Suspicious)	24.4%	14.0%

{Note 1} In 19.2% of the incidents, "Equipment Involved in Ignition" was either unknown or left blank.

{Note 2} In 7.8% of the incidents, "Form of Material Ignited" was either unknown or left blank.

{Note 3} In 23.7% of the incidents, "Ignition Factor" was either unknown or left blank.

In the first category of causal elements, *equipment involved in ignition*, Connecticut's fire experience was similar to many other states.[1] In fires where equipment was implicated in fire incidence, heating systems (8.0 percent of total reported fires) and cooking equipment (5.4 percent) were most often involved. More commonly, however, factors other than equipment were at play in the ignition of Connecticut's fires. In 1983, 58.0 percent of all NFIRS incidents and 61.4 percent of all NFIRS-reported fire deaths took place in fires where factors other than equipment were involved. In many of these cases, matches, lighters, and other smoking materials were directly implicated in ignition.

In Connecticut fires, the principal *forms of material ignited* were so-called "general form" materials, e.g., trees, grass, trash, and rubbish, which constituted 46.9 percent of all incidents. Less common but far more deadly (9.7 percent of all incidents and 52.6 percent of reported deaths) were fires involving furniture, apparel and soft goods—particularly mattresses, pillows, and bedding.

[1]In 19.2 percent of the Connecticut NFIRS incidents and 15.8 percent of the fire deaths, data pertaining to equipment involved in ignition was either unclassified or unknown. As a result, findings concerning this casual factor may not be fully representational.

The leading *factor of ignition* in Connecticut fires was arson, constituting 24.4 percent of all incidents and 14.0 percent of all fire deaths. Mechanical failure (involved in 18.7 percent of NFIRS incidents) and the misuse of heat of ignition (16.1 percent) constituted the remaining areas where the ignition factor was known. The latter factor—a particularly dangerous element—was implicated in 42.1 percent of all NFIRS-reported fire deaths. In fires involving the misuse of heat, leading elements were abandoned materials (which represented 8.8 percent of all incidents and resulted in 10 deaths), children playing (which caused 3.2 percent of the incidents and one death), and individuals falling asleep (which represented only 0.8 percent of the incidents but was implicated in four deaths).

CASUALTY SUMMARY

The number of casualties from Connecticut fires has increased significantly in recent years. Among the civilian population, the likelihood of injury or death was measured as 18.5 per 1,000 fires in 1982 compared to 20.0 in 1983. In structure fires, the number of casualties was still higher—58.2 per 1,000 fires in 1982 compared to 63.4 in 1983. For fire fighters, the general risk of casualty 24.4 per 1,000 fires in 1982 and 31.1 in 1983. In terms of structure fires, the number increased from 58.2 per 1,000 structure fires in 1982 to 63.4 in 1983.

MARYLAND

During 1983, 196 fire departments in Maryland submitted data to the National Fire Incident Reporting System (NFIRS). In this period, departments reported 21,074 incidents, resulting in a total of 56 deaths (including two fire fighters). As in other states, Maryland's fire problem is centered around structure fires, which represented 41.6 percent of the NFIRS incidents and 89.3 percent of the deaths. Other common fire situations in Maryland during 1983 were fires in trees, brush, and grasslands (22.2 percent) and vehicles (23.8 percent). A comparative listing of Maryland's fire activity with other states in Region I is provided in Table 8.1.

In terms of categories of fixed property use, the largest proportion of fire incidence in Maryland takes place in residential property (37.4 percent of all NFIRS incidents).[2] Table 8.2 provides an overview of fire incidence by fixed property use in Maryland and other states in Region I. As Table 8.2 indicates, in terms of fire incidence, Maryland experience in 1983 did not depart from the norm: in all states residential property fires are foreranking elements of the fire problem. What is of concern, with regard to Maryland data, however, is the role of residential fires in Maryland's fire death rate. In 1983, the percentage of residential fire deaths in Maryland was higher (87.5 percent) than both regional (82.4 percent) and national (72.6 percent) averages.

ELEMENTS OF FIRE INCIDENCE

Additional analysis of Maryland fire activity can be conducted by using NFIRS data to examine three major components of fire incidence: the equipment involved in a fire's ignition; the form of material first ignited; and the factors of ignition. Table Maryland-1, presented below, summarizes this data and a brief, explanatory overview follows.

[2]Information pertaining to fire incidence by fixed property use may not be altogether accurate because of a relatively high proportion (17.3 percent) of data that was not categorized by NFIRS respondents in Maryland.

TABLE MARYLAND-1

CAUSAL FACTORS OF MARYLAND FIRES

Equipment Involved in Ignition {1}	Fires	Deaths
—Heating Systems	11.7%	10.7%
—Cooking Equipment	3.9%	3.6%
—Electrical Distribution Equipment	4.3%	0.0
—Other/No Equipment	61.0%	69.6%

Form of Material Ignited {2}	Fires	Deaths
—Structural Framework	4.4%	10.7%
—Power Transformation	19.1%	16.1%
—General Form (Grass, Trash)	42.0%	3.6%
—Furniture/Soft Goods/Apparel	9.4%	5.4%

Ignition Factor {3}	Fires	Deaths
—Misuse of Heat	11.2%	8.9%
—Mechanical Failure	19.5%	3.6%
—Operational Deficiency	12.2%	7.1%
—Misuse of Material Ignited	2.7%	10.7%
—Arson (Incendiary, Suspicious)	17.2%	20.9%

{Note 1} In 14.4% of the incidents, "Equipment Involved in Ignition" was either left blank or unknown.

{Note 2} In 17.1% of the incidents, "Form of Material Ignited" was either unknown or left blank.

{Note 3} In 32.2% of the incidents, "Ignition Factor" was either unknown or left blank.

In instances where *equipment involved in ignition* was identified,[3] heating systems had the highest proportions in terms of both incidence (11.7 percent) and deaths (10.7 percent). More frequently, as is a common pattern throughout the nation, other factors besides equipment are implicated in ignition. During 1983, 61 percent of the fires in Maryland were ignited by other factors; 51.2 percent of these resulted from no equipment; e.g., lighters, matches, and other "non-equipment" causal elements.

The principal *forms of material ignited* in Maryland fires were trees, grass, rubbish, and trash (known as "general form" materials).[4] Fires where these materials initially burned represented 42.0 percent of Maryland's NFIRS incidents. Fortunately, these fires are inclined to have low rates of casualty; in Maryland, 3.6 percent of the state's deaths resulted from general form fires. Less frequent in incidence (9.4 percent) but far more threatening were fires where furniture (most often upholstered sofas and chairs)

[3]In 14.4 percent of the NFIRS incidents, Maryland respondents either did not know or left unclassified data pertaining to equipment involvement. As a result, findings pertaining to this topic may not be fully representational.

[4]These findings may not be fully representational due to a relatively high proportion (16.9 percent) of unknown or unclassified fires.

and soft goods (principally bedding) ignited: these fires were implicated in 55.4 percent of the state's NFIRS-reported deaths. The proportion of deaths in Maryland from furniture and soft goods was substantially higher than regional (26.2 percent) and national (29.3 percent) averages.

In terms of frequency of incidence, mechanical failure (19.5 percent) seems to be the leading *factor of ignition* in Maryland fires.[5] However, second-ranking in incidence and considerably more severe in terms of loss of life were arson-related fires, which were implicated in 20.9 percent of Maryland's fire deaths—a proportion considerably larger than regional (13.0 percent) and national (13.9 percent) averages.

CASUALTY SUMMARY

The risk of casualty—death or injury—from Maryland fires increased significantly during the past few years. For civilians, the number of casualties nearly doubled, rising from 8.7 per 1,000 fires in 1982 to 16.8 in 1983. Looking only at structure fires, the risk for civilians increased from 24.4 casualties per 1,000 fires in 1982 to 40.3 in 1983.

Among fire fighters, the general level of risk rose from 4.4 casualties per 1,000 fires to 9.5 in 1983. In terms of structure fires, the number increased from 12.4 casualties per 1,000 fires in 1982 to 22.8 in 1983.

MASSACHUSETTS

During 1983, 22,670 fires were reported to the National Fire Incident Reporting System by Massachusetts fire departments.[6] These incidents resulted in 66 deaths among the state's civilian population; no deaths among fire fighters were reported to NFIRS during the year.

As Table 8.1 indicates, unlike many other states, the proportion of vehicle fires (39.6 percent) outweighed the incidence of structure fires (31.5 percent) in Massachusetts. Fortunately, despite the high incidence of vehicle fires, the incidence of related fire deaths (7.8 percent) was less than regional (11.0 percent) and national (19.0 percent) averages. As was common throughout the nation, both structure and vehicle fires constituted the major portion (71.2 percent collectively) of the state's fire problem. Over 90.0 percent of the state's fire deaths were attributable to structure fires.

A similar pattern emerges when fire activity is analyzed by fixed property use. Residential incidents, which represented 23.0 percent of all NFIRS-reported fires in Massachusetts, resulted in over 90.0 percent of the state's fire deaths—a proportion of incidence that is higher than averages for both the region (82.4 percent) and the nation (72.6 percent). A complete listing of fire incidence by category of fixed property use in Massachusetts and other states in Region I is presented in Table 7.2.

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[5]A large proportion (32.0 percent of all reported fires and 35.7 percent of all deaths) were unclassified pertaining to factors of ignition by Maryland respondents. As a result, the accuracy of these findings are unclear.

[6]More than three-fourths (79.7 percent) of Massachusetts 366 fire departments participated in the National Fire Incident Reporting System during this time period. These departments are to be commended for their high level of participation and general support of NFIRS.

ELEMENTS OF FIRE INCIDENCE

To further explore 1983 fire activity, we have used Massachusetts NFIRS data to analyze three major causal elements of fire incidence: the equipment involved in ignition, the form of material first ignited, and the factors of ignition. The findings of this analysis are impaired by a relatively large proportion of unclassified or unknown responses in each category. In reviewing the following sections, readers are advised that the findings may not always be accurate or fully representational.

TABLE MASSACHUSETTS-1

CAUSAL FACTORS OF MASSACHUSETTS FIRES

Equipment Involved in Ignition {1}	**Fires**	**Deaths**
—Heating Systems	4.4%	7.6%
—Cooking Equipment	3.3%	3.0%
—Electrical Distribution Equip.	3.3%	4.5%
—Other/No Equipment	41.3%	54.5%
Form of Material Ignited {2}	**Fires**	**Deaths**
—Structural Framework	9.2%	21.2%
—Power Transformation	13.3%	6.1%
—General Form (Grass, Trash)	6.6%	4.5%
—Furniture/Soft Goods/Apparel	14.7%	40.9%
Ignition Factor {3}	**Fires**	**Deaths**
—Misuse of Heat	9.5%	37.8%
—Mechanical Failure	16.9%	3.0%
—Operational Deficiency	5.0%	9.0%
—Misuse of Material Ignited	4.9%	3.0%
—Arson (Incendiary, Suspicious)	24.2%	1.5%

{Note 1} In 43.2% of the incidents, "Equipment Involved in Ignition" was either unknown or left blank.

{Note 2} In 40.8% of the incidents, "Form of Material Ignited" was either unknown or left blank.

{Note 3} In 35.8% of the incidents, "Ignition Factor" was either unknown or left blank.

As the preceding table indicates, in instances where cause was known and recorded, the *equipment involved in ignition* most often was heating systems (4.3 percent), which resulted in 7.6 percent of all fire deaths in Massachusetts. Cooking equipment (3.3 percent of all incidents) and electrical distribution equipment (3.3 percent) also were prominent factors. In Massachusetts, 41.3 percent of the fires in which no equipment was involved in ignition resulted in 54.5 percent of the state's fire deaths. Equipment involvement was either unknown or unrecorded in 43.2 percent of Massachusetts NFIRS incidents and 45.5 percent of NFIRS-reported fire deaths.

In terms of both fire incidence and fire deaths, the leading *forms of material ignited* were furniture, soft goods, and apparel. Together, these categories constituted 14.7 percent of the fire incidents, and 40.9 percent of all fire deaths. Power transformation

equipment and fuel was responsible for a similar proportion of the fire incidents (13.3 percent), but was involved in only 6.1 percent of the state's fire fatalities.

The leading *ignition factor* in Massachusetts fires was arson-related (24.2 percent). Massachusetts had a higher proportion of incendiary (5.2 percent) and suspicious (18.8 percent) fires than any other state in the nation. Other prominent factors in the ignition of fires in Massachusetts were mechanical failure (16.9 percent) and misuse of heat of ignition (9.5 percent).

CASUALTY SUMMARY

Reported casualties have declined slightly in Massachusetts during the past year.[7] In 1983, fire fighter casualties per 1,000 fires was 31.2 compared to 34.2 in 1982. For structure fires, fire fighter casualties declined from 105.2 in 1982 to 99.1 per 1,000 structure fires in 1983. Among the state's civilian population, casualties in structure fires remained relatively stable—55.3 in 1982 to 55.1 per 1,000 structure fires in 1983. In general, civilian casualties decreased from 18.0 per 1,000 fires in 1982 to 17.4 in 1983.

NEW JERSEY

In 1983, New Jersey fire departments reported 10,318 incidents to NFIRS.[8] Seven deaths among civilians were reported to NFIRS during the year and none among fire fighters. Based on department reports, the most common situations found were tree, grass, and brush fires (36.0 percent of all reported incidents). Other critical components of the New Jersey fire problem in 1983 were structure fires (23.8 percent) and vehicle fires (19.1 percent). Structure fires were implicated in 71.4 percent of all NFIRS-reported deaths. Table 8.1 provides a comparative listing of fire situations found in New Jersey and other states in Region I.

A comparative analysis of fire incidence by fixed property use (See Table 8.2) indicates that, like other states, the core of New Jersey's fire activity was in residential and special properties. In terms of frequency of occurrence, special property fires—particularly involving outdoor and roadway locations—had the highest proportion (37.0 percent). Residential fires, while less frequent, posed the greatest threat to public safety (71.4 percent of NFIRS-reported deaths).

ELEMENTS OF FIRE INCIDENCE

To provide a more detailed look at 1983 fire activity in New Jersey, NFIRS data can be used to analyze three major casual elements of fire incidence: the equipment involved

[7]Boston NFIRS data did not contain casualty data for 1983. This may have altered the accuracy of aggregate findings pertaining to casualties.

[8]During 1983, only 152 (21.1 percent) of New Jersey's 721 fire departments participated in the National Fire Incident Reporting System. Analysis of this state's fire experience is significantly affected by this underreporting and the accuracy of findings regarding New Jersey fire activity may be impaired.

in ignition; the form of material first ignited; and the ignition factor. Table New Jersey-1 summarizes state's experience as it relates to each of these factors and is followed by a brief descriptive overview.

TABLE NEW JERSEY-1

CAUSAL FACTORS OF NEW JERSEY FIRES

Equipment Involved in Ignition {1}	**Fires**	**Deaths**
—Heating Systems	3.6%	0.0
—Cooking Equipment	3.3%	0.0
—Electrical Distribution Equip't.	3.2%	0.0
—Other/No Equipment	33.1%	71.4%
Form of Material Ignited {2}	**Fires**	**Deaths**
—Structural Framework	4.6%	14.3%
—Power Transformation	11.9%	14.3%
—General Form (Trees, Rubbish)	40.5%	0.0
—Furniture/Soft Goods/Apparel	3.6%	71.4%
Factors of Ignition {3}	**Fires**	**Deaths**
—Misuse of Heat	17.1%	42.8%
—Mechanical Failure	13.5%	28.6%
—Operational Deficiency	3.9%	0.0
—Misuse of Material Ignited	3.6%	0.0
—Arson (Incendiary, Suspicious)	15.5%	14.3%

{Note 1} In 52.5% of the incidents, "Equipment Involved in Ignition" was either unknown or left blank.

{Note 2} In 24.1% of the incidents, "Form of Material Ignited" was either unknown or left blank.

{Note 3} In 40.5% of the incidents, "Ignition Factor" was either unknown or left blank.

In incidents where *equipment involvement in ignition* was identified, leading factors were heating systems (3.6 percent) and cooking equipment (3.3 percent).[9] However, as in other states, more commonly no equipment was attributable to the cause of ignition. In 1983, 33.1 percent of all NFIRS incidents and 71.4 percent of the fire deaths were caused by fires ignited by factors other than equipment. Frequently, such fires were caused by matches and other smoking materials.

The forms of material ignited in New Jersey fires were most frequently "general form" materials; e.g., trees/grass (25.9 percent) and rubbish/trash (11.9 percent). Other principal forms included structural framework; power transformation; furniture, soft goods and apparel.[10]

[9]NFIRS responses regarding equipment involvement were left unclassified in 52.5 percent of the incidents in New Jersey. As a result, findings pertaining to equipment and ignition may not be fully representational.

[10]NFIRS responses regarding the form of material ignited were unclassified in 24.1 percent of the New Jersey incidents, which impairs the accuracy of these findings.

In terms of proportions of both fire deaths and incidents, the leading *factor of ignition* in New Jersey fires was the misuse of heat (accounting for 42.8 percent and 17.1 percent respectively). Of these incidents, ignition resulting from abandoned material, which was involved in 8.1 percent of all NFIRS-reported fires, and from children playing, which was a factor in 4.1 percent, were particularly critical elements. Other prominent ignition factors in New Jersey fires were arson (15.5 percent) and mechanical failure (13.5 percent).

CASUALTY SUMMARY

According to New Jersey NFIRS data, the risk of fire-related casualty increased between 1982 and 1983. Among fire fighters, the number of casualties per 1,000 fires increased from 9.6 to 13.3 in 1983. In structure fires, the likelihood of casualties among fire fighters increased from 50.7 in 1982 to 68.3 in 1983.

Among the state's civilian population, the number of casualties increased from 7.5 per 1,000 fires to 10.6 in 1983. And, the risk of injury or death increased from 39.4 per 1,000 structure fires in 1982 to 44.3 in 1983.

NEW YORK

More than three-fourths (81.7 percent) of the 1,796 fire departments in New York participated in the National Fire Incident Reporting System. We commend New York fire departments for this comparatively high rate of participation in NFIRS.

During 1983, these departments reported 55,624 incidents, which resulted in 144 fire deaths (135 among civilians and 9 among fire fighters). According to NFIRS data, the most common incidents reported by fire departments were structure fires (39.6 percent) and vehicle fires (18.6 percent). These two categories also accounted for 98.6 percent of New York's fire fatalities. A comparative listing of incidents occurring in New York and throughout the region is presented in Table 8.1.

Looking at New York's fire experience by categories of fixed property use indicates that—as in other states—the core of the fire problem largely was found in residential incidents. In 1983, 30.9 percent of the incidents and 71.5 percent of the deaths reported to NFIRS resulted from residential property fires. As is indicated in Table 8.2, unlike other states, New York fire departments reported a comparatively low incidence of fires in special property—15.0 percent. However, the death rate from NFIRS-reported special property fire was higher than regional averages (13.2 percent vs. 8.4 percent).

ELEMENTS OF FIRE INCIDENCE

A more detailed analysis of New York's fire activity can be undertaken by examining NFIRS data as they relate to three major causal elements of the fire problem: the equipment involved in ignition; the form of material initially ignited, and the ignition factor. Table New York-1 summarizes this information and is followed by a brief descriptive overview.

TABLE NEW YORK-1

CAUSAL FACTORS OF NEW YORK FIRES

Equipment Involved {1}	**Fires**	**Deaths**
—Heating Systems	15.8%	16.7%
—Cooking Equipment	4.4%	5.6%
—Electrical Equipment	6.4%	6.3%
—None/Other	9.2%	12.5%

Form of Material Ignited {2}	**Fires**	**Deaths**
—Structural Framework	10.6%	27.1%
—Power Transformation	11.8%	11.1%
—General Form (Grass, Trash)	9.6%	0.7%
—Furniture/Soft Goods/Apparel	6.8%	19.4%
—Special Form (Atomized, Vaporized Liquid)	6.2%	7.6%

Ignition Factor {3}	**Fires**	**Deaths**
—Misuse of Heat	7.2%	20.1%
—Mechanical Failure	19.8%	16.7%
—Operational Deficiency	12.3%	17.4%
—Arson (Incendiary, Suspicious)	7.9%	16.7%

{Note 1} In 53.6% of the incidents, "Equipment Involved in Ignition" was either unknown or left blank.

{Note 2} In 48.7% of the incidents, "Form of Material Ignited" was either unknown or left blank.

{Note 3} In 43.3% of the incidents, "Ignition Factor" was either unknown or left blank.

As the above table illustrates, in New York, heating systems was the type of *equipment most frequently involved in ignition*—in terms of both incidence (15.8 percent) and deaths (16.7 percent).[11] In 9.2 percent of the New York fires, however, other factors—such as matches and smoking materials—were involved. These fires resulted in the same proportion of deaths as incidents caused by heating systems—16.7 percent.

A principal *form of material ignited* in New York fires was structural composition and finish. In 1983, this form of material was involved in 10.6 percent of all incidents and 27.1 percent of the fire deaths.[12] Furniture, soft goods, and apparel fires, while considerably less frequent (6.8 percent of all fires), represented a substantial threat to public safety (19.4 percent of the state's NFIRS fire deaths).

Leading *factors of ignition* in New York fires were mechanical failure (19.8 percent of all incidents and 16.7 percent of all deaths) and operational deficiency (12.3 percent; and 17.4 percent of all deaths). While slightly less common, fires started by the misuse of heat of ignition (7.2 percent) were quite deadly (20.1 percent). Of these fires, incidents

[11]In 53.6 percent of the NFIRS incidents and 50 percent of the fire deaths, the equipment involved in ignition was either unknown or unclassified. As a result, findings pertaining to equipment involvement may not be fully representational.

[12]In 48.7 percent of the New York's NFIRS fires, the form of material was either unknown or unclassified. As a result, these findings may not be fully representational.

occurring from abandoned materials (2.6 percent of all fires and 6.9 percent of all deaths) and from individuals falling asleep (0.6 percent and 4.9 percent) were particularly significant. New York also had a comparatively high incidence of arson-related fires (7.9 percent). Of the fire deaths that were reported in 1983, 16.7 percent were attributable to incendiary or suspicious incidents.

CASUALTY SUMMARY

Based on the analysis of NFIRS data, the likelihood of incurring casualties in New York fires increased slightly between 1982 and 1983. For civilians, casualties per 1,000 fires rose from 14.4 in 1982 to 16.7. The proportion was substantially larger in fires occurring in structures—38.1 casualties per 1,000 structure fires in 1982 compared to 42.4 in 1983. The amount of increase in structure fire casualties was smaller for fire fighters. In 1982, 86.9 casualties per 1,000 structure fires were reported compared to 88.2 in 1983. In general, the level of casualties among fire fighters was 34.8 per 1,000 fires compared to 32.8 in 1982.

RHODE ISLAND

An impressively large proportion of Rhode Island fire departments participated in the National Fire Incident Reporting System in 1983. Ninety-two (92.3 percent) of the 78 fire departments in Rhode Island submitted data in this period. During 1983, these departments reported 7,903 incidents which resulted in ten deaths among Rhode Island's civilian population. One fire fighter death was recorded during this period. Unlike many states, the greatest number of Rhode Island fires involved trees, grass, and brush (38.7 percent of the incidents). However, these fires were not associated with any deaths. As Table 8.1 indicates, the core of the state's fire problem was found in structure fires: 23.2 percent of all reported incidents and 81.8 percent of all reported fire deaths were attributable to incidents in structures.

In terms of fire incidence and fixed property use (see Table 8.2), fires most often occurred in special property categories—e.g., outdoors, roadways, and other such areas. During 1983, based on NFIRS reports, 64.4 percent of all Rhode Island's fire incidents occurred in the special property category. Of the states in Region I, Rhode Island departments also reported the highest proportion of deaths (27.3 percent) in this category (the regional average was 8.4 percent). In turn, Rhode Island had a considerably lower incidence of residential fires (18.0 percent compared to 29.4 percent of the region) and the smallest proportion of residential fire deaths (45.4 percent compared to 82.4 percent for the region and 72.6 percent nationally).

ELEMENTS OF FIRE INCIDENCE

A better understanding of Rhode Island's fire activity can be achieved through an analysis of NFIRS data using three major causal elements: the equipment involved in ignition; the form of material first ignited; and the ignition factor. The following table summarizes the principal findings of this analysis and is followed by a brief descriptive overview.

TABLE RHODE ISLAND-1

CAUSAL FACTORS OF RHODE ISLAND FIRES

Equipment Involved in Ignition {1}	Fires	Deaths
—Heating Systems	7.3%	9.1%
—Cooking Equipment	2.9%	0.0
—Electrical Distribution Equipment	2.7%	18.2%
—Other/No Equipment/Vehicle	71.1%	36.4%

Form of Material Ignited {2}	Fires	Deaths
—Structural Framework	6.5%	45.5%
—Power Transformation	12.1%	9.1%
—General Form (Grass, Trash)	57.8%	0.0
—Furniture/Soft Goods/Apparel	6.8%	18.2%

Ignition Factor {3}	Fires	Deaths
—Misuse of Heat of Ignition	10.7%	18.2%
—Mechanical Failure	13.8%	9.1%
—Operational Deficiency	4.0%	18.2%
—Arson (Incendiary, Suspicious)	31.5%	9.1%

{Note 1} In 11.2% of the incidents, "Equipment Involved in Ignition" was either unknown or left blank.

{Note 2} In 4.7% of the incidents, "Form of Material Ignited" was either unknown or left blank.

{Note 3} In 32.9% of the incidents, "Ignition Factor" was either unknown or left blank.

As the preceding table indicates, in fires where *equipment was involved in ignition*, heating systems were most often implicated (7.3 percent of all incidents and 9.1 percent of all fire deaths). Most often, however, other factors were involved in Rhode Island fires. Such fires, which represented 71.1 percent of all incidents, were implicated in 36.4 percent of the NFIRS-reported deaths.

In terms of *forms of material ignited*, most fires in Rhode Island involved general form material, e.g., trees, grass, rubbish, and trash. In 1983, over half (57.8 percent) of the fires reported to NFIRS were general form fires. However, no deaths were reported from such incidents. While less common in occurrence, fires where structural composition and finish were ignited were implicated in 45.5 percent of the fire deaths reported in Rhode Island.

During 1983, the leading *ignition factor* in Rhode Island fires was arson-related: 31.5 percent of the incidents reported in Rhode Island and 9.1 percent of the deaths were attributed to fires started by incendiary or suspicious circumstances. Another leading factor in Rhode Island fires was mechanical failure, which constituted 13.8 percent of the NFIRS incidents and 9.1 percent of the deaths.[13] While less likely to occur, particularly deadly fires involved misuse of heat ignition (18.2 percent of the fire deaths) and operational deficiencies (18.2 percent).

[13]In 32.9 percent of the NFIRS incidents and 36.4 percent of the fire deaths, the ignition factor was either unclassified or unknown. As a result, findings pertaining to ignition factors may not be fully representational.

CASUALTY SUMMARY

Among the civilian population, the amount of casualties has remained stable in the past few years. During 1982, there were 10.3 casualties per 1,000 fires compared to 10.0 in 1983. In structure fires, which have a substantially higher risk of injury and death, the number of casualties per 1,000 structure fires was 43.9 in 1982 compared to 43.2 in 1983.

For fire fighters, the likelihood of casualties has increased slightly. In general terms, the number of fire fighter casualties per 1,000 fires was 15.2 in 1982 and 16.2 in 1983. In structure fires, the number of casualties was 64.9 per 1,000 fires in 1982 and 69.9 in 1983.

VERMONT

The rigorous level of support by Vermont fire departments to the National Fire Incident Reporting System warrants special attention. Nearly 90 percent (86.6) of the 210 fire departments in Vermont participated in NFIRS in 1983. The U.S. Fire Administration thanks Vermont participants for their assistance. During this period, Vermont departments reported 4,152 incidents—of these, 29 deaths were reported—all of which occurred among the civilian population. By far, the most critical element of Vermont's fire problem in 1983 was in structural fires (67.6 percent of the state's NFIRS total) which accounted for more than 95 percent (96.6) of the state's NFIR's ire deaths. Vermont's structural fire record was also considerably higher than the national average for structural fire incidence (35.8 percent) and structural fire deaths (77.6 percent).

An examination of fire incidence by categories of fixed property use, provided in Table 8.2, indicates that Vermont had the highest incidence of residential fires of the states in Region I. During 1983, Vermont reported 60.0 percent of all fires as those in residential occupancies compared to 29.4 percent for the region as a whole and 30.3 the nation. The proportion of residential fire deaths (93.1 percent), while not the highest of the eight states, was also considerably larger than the average for the region (82.4 percent) and the nation (72.6 percent).

ELEMENTS OF FIRE INCIDENCE

Further analysis of Vermont's fire activity can be accomplished by reviewing NFIRS data measured against three major causal elements of fire incidence: the equipment involved in ignition; the form of material first involved in ignition; and the ignition factor. Table Vermont-1 summarizes the findings pertaining to causal elements and is followed by a brief descriptive overview.

In Vermont fires, *equipment involved in ignition* most often was heating systems. In 1983, 41.6 percent of all incidents and 34.5 percent of all deaths were fires where heating systems—principally fixed heaters—were implicated in ignition. Vermont stands well above regional and national averages in this respect. In other areas, Vermont's experience is comparable to many other states. For example, in 41.4 percent of the reported incidents and 48.3 percent of the fire deaths, no equipment or other non-standard forms of equipment were involved in ignition.

The leading *forms of material ignited* are the so-called "general form" materials; e.g., trees, grass, rubbish, and trash; which were involved in 53.3 percent of all incidents and 10.3 percent of the fire deaths reported to NFIRS from Vermont. While less common in occurrence (12.6 percent), fires where structural framework was ignited posed a critical safety threat (41.4 percent of all NFIRS fire deaths).

Of all the *ignition factors* in Vermont incidents those involving operational deficiencies (40.6 percent) were, by far, the most frequent in occurrence. However, these fires had a comparatively low rate of death (3.4 percent). Less common but more deadly were fires that involved design and construction deficiencies (24.1 percent of NFIRS fire deaths), misuse of material ignited (20.7 percent), mechanical failure (17.2 percent), and misuse of heat ignition (17.1 percent).

TABLE VERMONT-1

CAUSAL FACTORS OF VERMONT FIRES

Equipment Involved in Ignition {1}	**Fires**	**Deaths**
—Heating Systems	41.6%	34.5%
—Cooking Equipment	3.3%	3.4%
—Electrical Distribution Equipment	5.1%	3.4%
—Other/No Equipment (matches, etc.)	41.4%	48.3%
Form of Material Ignited {2}	**Fires**	**Deaths**
—Structural Framework	12.6%	41.4%
—Power Transformation	9.8%	0.0
—General Form (Grass, Trash)	53.3%	10.3%
—Furniture/Soft Goods/Apparel	5.3%	34.5%
Ignition Factor {3}	**Fires**	**Deaths**
—Misuse of Heat	11.7%	17.2%
—Mechanical Failure	12.9%	17.2%
—Operational Deficiency	40.6%	3.4%
—Arson (Incendiary, Suspicious)	9.6%	3.4%
—Misuse of Material	5.1%	20.7%
—Design/Construction Deficiency	4.0%	24.1%

{Note 1} In 4.6% of the incidents, "Equipment Involved in Ignition" was either unknown or left blank.

{Note 2} In 5.1% of the incidents, "Form of Material Ignited" was either unknown or left blank.

{Note 3} In 9.4% of the incidents, "Ignition Factor" was either unknown or left blank.

CASUALTY SUMMARY

Reported casualties in Vermont have decreased significantly in recent years. Among the civilian population, the risk casualty in general declined from 21.0 per 1,000 fires in 1982 to 17.1 in 1983. In structure fires, the incidence declined from 44.5 per 1,000 fires to 25.3. Among fire fighters, the number of casualties decreased from 19.7 per 1,000 fires to 14.0 in 1983. Similar strides were made in terms of structure fires where the amount of risk decreased from 41.7 casualties per 1,000 fires to 20.7 in 1983.

WASHINGTON, D.C.

There is only one fire department in Washington, D.C., and that department participated in NFIRS in 1983. Because of the high level of NFIRS participation, it is expected that data included in these analyses are fairly representational of Washington, D.C.'s fire problem.

During 1983, departments reported 5,883 incidents to NFIRS, resulting in 11 civilian fire deaths and no fatalities among fire fighters. Like other states, the bulk of Washington's 1983 fire problem was structure fires, which constituted 39.4 percent of all incidents, and 100 percent of all fire fatalities. Washington, D.C. also exhibited an unusually high incidence of refuse fires (27.2 percent)—considerably higher than in either the region (16.3 percent) or the nation (15.8 percent). Fortunately, no deaths were attributable to these fires. A comparative listing of fire situations found in Washington, D.C., and in the region as a whole can be found in Table 8.1

Additional insights into Washington, D.C.'s fire problem can be made by examining NFIRS data in terms of categories of fixed property use. In Washington, the core of the fire problem, constituting 32.9 percent of all incidents and 100 percent of all fire deaths takes place in residential properties. Special properties—outdoor areas, construction sites, rail and roadways, and other such property—were the locations of the second largest proportion of fires (29.9 percent), however, no deaths were attributable to these fires. Washington, D.C. had an unusually high percentage of fire incidents which were unclassified—25.5 percent versus 9.3 percent nationally.

ELEMENTS OF FIRE INCIDENCE

Further analysis of Washington, D.C.'s 1983 fire experience can be undertaken by using NFIRS data to examine three major causal elements of fire incidence: equipment involved in fire ignition; the form of material first ignited; and the ignition factor. Table DC-1 provides information about the involvement of these causal elements and a brief discussion of their implications for Washington, D.C.

TABLE DC-1

CAUSAL FACTORS OF WASHINGTON, D.C. FIRES

Equipment Involved in Ignition {1}	Fires	Deaths
—Heating Systems	2.2%	27.3%
—Cooking Equipment	5.3%	0.0
—Electrical Distribution	4.5%	9.1%
—Other No Equipment	64.0%	27.3%

Form of Material Ignited {2}	Fires	Deaths
—Structural Framework	6.2%	36.4%
—Power Transformation	13.5%	9.1%
—General Form (Grass, Trash)	35.0%	9.1%
—Furniture Soft Goods Apparel	13.7%	45.5%

Ignition Factor {3}	Fires	Deaths
—Misuse of Heat	21.2%	18.2%
—Mechanical Failure	16.3%	18.2%
—Operational Deficiency	4.3%	0.0
—Arson (Incendiary, Suspicious)	24.8%	18.2%

{Note 1} In 18.3% of the incidents, "Equipment Involved in Ignition" was either unknown or left blank.

{Note 2} In 12.4% of the incidents, "Form of Material Ignited" was either unknown or left blank.

{Note 3} In 24.3% of the incidents, "Ignition Factor" was either unknown or left blank.

In incidents where *equipment was involved in ignition*, heating systems, which represented 2.2 percent of the incidents, and 27.3 percent of the deaths, and cooking equipment, which was implicated in 5.3 percent of the fires and no deaths, had the highest proportion of involvement. In Washington, D.C., as in other states, fires were frequently ignited by other factors besides the principal categories of equipment. In 1983, 64.0 percent of all fires and 27.3 percent of all deaths were reportedly caused by no equipment or other non-standard equipment. Washington, D.C. had an extremely high proportion of fires in which no equipment was involved, suggesting that misuse of smoking materials (matches, lighters, etc.) may be particularly problematic in Washington, D.C. In 18.3 percent of the District of Columbia's incidents, equipment involvement was either unknown or unclassified by NFIRS respondents. Because of this, the preceding data findings may not be fully representational.

The *forms of material* most frequently *ignited* were those in the "general form" category; e.g., trees, grass, brush and rubbish. These materials were identified as the materials ignited in 35.0 percent of all reported incidents and 9.1 percent of all Washington, D.C. fire deaths. Furniture, soft goods and apparel were the forms of material ignited which caused the highest incidence of deaths, 45.5 percent. The concentration of fire deaths in this category is considerably greater than in the region (26.2 percent) or in the nation (29.3 percent). It is important to emphasize that in 12.4 percent of the incidents, the form of material ignited was not identified by District NFIRS respondents. As a result, these findings may not be completely representational.

Ignition factors in Washington, D.C. most often include arson, responsible for 24.8 percent of the incidents, and 18.2 percent of the deaths. No single ignition factor emerged as principally responsible for Washington's fire deaths—rather, the deaths, where the ignition factor was known, were spread fairly evenly over misuse of heat, mechanical failure and arson. Another leading factor in fire incidence, was mechanical failure, representing 16.3 percent of all incidents reported. Again, it must be emphasized, in 24.3 percent of the incidents, the ignition factor was not identified by District NFIRS respondents. Because of this, the representational nature of these data is in question.

CASUALTY SUMMARY

The risk of casualty from fire grew dramatically for Washingtonians between 1982 and 1983. The civilian casualties per 1,000 structure fires grew from 26.4 in 1982 to 62.0 in 1983. For fires overall, the casualties per 1,000 fires rose from 10.1 in 1982 to 24.5 in 1983.

For district fire fighters, the casualty risk increased at a much slower rate between 1982 and 1983. Between 1982 and 1983, the fire fighter casualties per 1,000 fires rose from 8.6 to 11.6. For fire fighter casualties per 1,000 structure fires, the rate rose from 21.4 in 1982 to 29.3 in 1983.

FIRE ACTIVITY IN REGION II

Stretching along much of the southeastern coast, Region II includes the states of Arkansas, Florida, Louisiana, South Carolina, Tennessee, Virginia, and West Virginia. In Alabama, the fire departments of only one municipality—Birmingham—submitted data to the National Fire Incident Reporting System. Because of this, Alabama has been excluded from this analysis. North Carolina and Kentucky, although NFIRS participants, did not submit data during 1983. Two remaining states—Mississippi and Georgia —did not participate in NFIRS and, hence, are not included in this analysis.

In 1983, NFIRS reporting fire departments throughout Region II submitted data on a total of 87,181 fires and 441 fire fatalities. While data contained in this analysis can suggest general regional trends, the uneven participation by fire departments in these states may over or understate a particular aspect of the region's fire problem. For example, in South Carolina, less than 3 percent of that state's fire departments participated in NFIRS in 1983, while in West Virginia, NFIRS participation exceeded 95 percent. The result of these far-ranging levels of NFIRS participation is that data represent different levels of completeness, and, as such, the reader must bear this in mind when reviewing these findings.

1983 FIRE RECORD

According to NFIRS data, Region II experienced the highest incidence of structural fires of all four regions of the country. Structure fires accounted for slightly less than 80 percent (79.6) of the deaths in Region II. Another key element of the fire problem—vehicle fires—was reported at about the same rate of incidence in Region II (24.2 percent) as in the nation as a whole (24.6 percent). The death rate from these fires, however, was considerably lower in Region II (16.3 percent) than was experienced nationally (19.0 percent). A comparative listing of fire situations found in Region II is presented in Table 8.4.

A more detailed analysis of fire activity in Region II can be gained by reviewing the fire incidence data by fixed property use category, as displayed in Table 8.5. In Region II, residential fires constituted 36.0 percent of all fires—a proportion higher than the national average of 30.3. In addition, the regional death rate from residential fires (75.1 percent) was also higher than the national average of 72.6 percent. Special property fires in Region II, however, constituted less of the total number of either incidents or deaths than those experienced by the nation as a whole.

ELEMENTS OF FIRE INCIDENCE

By examining three causal elements of the fire problem—the equipment involved in ignition, the form of material ignited, and the ignition factor—additional insights into Region II's fire problems can be gained. The table below summarizes the findings of this type of examination and a more detailed discussion is provided in the following sections of this analysis.

FIRE INCIDENCE IN REGION II BY SITUATION FOUND

State	NFIRS Fires	NFIRS Deaths	Structure Fires		Vehicle Fires		Trees, Grass, Brush Fires		Refuse Fires		Other Fires[1]		Unclassified	
			Fires%	Deaths%	Fires%	Deaths%	Fires%	Deaths%	Fires%	Deaths%	Fires%	Deaths%	Fires%	Deaths%
Arkansas	8,493	44	42.2	84.1	21.4	11.4	24.9	—	9.7	4.5	1.7	-	.04	—
Florida	32,755	126	31.9	76.2	27.2	15.9	23.8	1.6	12.7	—	4.4	6.3	—	—
Louisiana	16,404	108	46.0	77.8	25.0	20.4	15.5	—	10.6	—	2.8	1.8	.05	—
South Carolina	1,083	4	30.7	100.0	28.3	—	27.0	—	13.0	—	1.0	—	—	—
Tennessee	8,706	50	42.6	76.0	21.7	22.0	22.7	—	11.6	—	1.3	2.0	—	—
Virginia	11,164	50	45.9	84.0	20.5	14.0	16.5	2.0	12.5	—	3.2	—	1.3	—
West Virginia	8,576	59	60.5	84.7	21.0	11.9	9.9	—	6.6	—	1.9	3.4	—	—
Region II Total	87,181	441	41.3	79.6	24.2	16.3	20.0	.7	11.3	.5	3.1	2.9	.2	—
U.S. Total	767,310	2,298	35.8	77.6	24.6	19.0	19.9	.9	15.8	.3	3.8	2.2	.05	—

[1]"Other" includes incidents found outside of structures, explosions, outside spills and leaks, and miscellaneous fires.

Table 8.4

FIRE INCIDENCE IN REGION II BY FIXED PROPERTY USE

State	NFIRS Fires	NFIRS Deaths	Public, Educational Institutional		Residential		Commercial Industrial Storage		Special		Unclassified	
			Fires%	Deaths%	Fires%	Deaths%	Fires%	Deaths	Fires%	Deaths%		
Arkansas	8,493	44	3.7	—	32.9	81.8	8.7	2.3	29.3	4.5	25.4	11.4
Florida	32,755	126	4.0	1.6	28.3	68.3	9.6	6.3	46.6	20.6	11.5	3.2
Louisiana	16,404	108	3.8	1.9	42.0	75.9	13.1	.9	37.1	20.4	4.0	.9
South Carolina	1,083	4	3.3	—	27.7	75.0	9.4	—	41.4	25.0	18.2	—
Tennessee	8,706	50	2.5	—	38.4	74.0	11.2	2.0	39.4	22.0	8.5	2.0
Virginia	11,164	50	4.5	4.0	42.9	78.0	10.4	2.0	36.3	16.0	5.9	—
West Virginia	8,576	59	2.8	—	47.4	81.4	11.2	10.2	38.0	8.5	.6	—
Region II Total	87,181	441	3.8	1.4	36.0	75.1	10.6	4.1	40.2	17.0	9.5	2.6
U.S. Total	767,310	2,298	3.7	1.4	30.3	72.6	9.7	4.6	46.9	19.1	9.3	2.2

Table 8.5

CAUSAL FACTORS OF REGION II FIRES

Equipment Involved in Ignition	Fires	Deaths
—Heating Systems	9.2%	12.0%
—Cooking Equipment	6.0%	4.3%
—Electrical Distribution	5.4%	3.7%
—Other Remaining Categories of Equipment	6.3%	7.6%
—No Equipment/Vehicle/Non-Standard Equipment	57.0%	49.0%
—Unknown/Blank/Invalid	16.1%	23.4%
Totals	100.0%	100.0%

Form of Material Ignited	Fires	Deaths
—Structural Framework	9.9%	15.9%
—Power Transformation	19.1%	17.3%
—General Form (Grass, Trash)	37.5%	2.0%
—Furniture/Soft Goods/Apparel	9.1%	26.2%
—Other Remaining Categories	12.1%	14.8%
—Unknown/Blank/Invalid	12.3%	23.8%
Totals	100.0%	100.0%

Ignition Factor	Fires	Deaths
—Misuse of Heat	14.2%	16.5%
—Mechanical Failure	22.8%	12.2%
—Operational Deficiency	10.2%	13.4%
—Misuse of Materials		
—Arson (Incendiary Suspicious)	14.3%	13.0%
—Other Remaining Categories	11.7%	10.1%
—Unknown/Blank/Invalid	26.8%	34.8%
Totals	100.0%	100.0%

Table 8.6

SUMMARY

Region II's fire activity was primarily concentrated within structures. During this period, 41.3 percent of all Region II fires were structure fires. Further, Region II rates were the highest of the four regions.

When categories of fixed property use fire incidence are compared to national data, we see that with the exception of residential and special property fires, Region II's fire experience is quite similar to national averages.

When regional data pertaining to equipment involved in ignition data were compared to national averages, findings indicated that Region II experienced much greater rates of fire incidence where no equipment was involved in ignition (57.0 percent). A closer review revealed that, of these, close to half involved no equipment, suggesting that matches and other smoking materials may be particularly problematic in the ignition of Region II fires.

When ignition factor data were analyzed, they revealed that Region II appears to experience fewer arson (incendiary or suspicious) fires than is true nationally (14.3 percent vs. 17.3 percent).

ARKANSAS

A comparatively small proportion—24.8 percent—of the 605 fire departments in Arkansas participated in the National Fire Incident Reporting System during 1983. Because of this relatively low level of participation, NFIRS data pertaining to Arkansas' fire experience for this period is not fully representational and any analysis is limited. Readers are advised to bear this in mind in the course of their review of material pertaining to Arkansas throughout this report.

During 1983, departments reported 8,493 fire incidents to NFIRS. From these, 44 fire deaths resulted, all among civilians. As in many other states, the crux of Arkansas' fire problem lies in structure fires, which constituted 42.2 percent of all NFIRS-reported incidents and 84.1 percent of the deaths. Other particularly prevalent fire situations were outside fires (involving trees, grass, and brush), which represented 24.9 percent of the incidents, and vehicle fires, which were the sites of 21.4 percent of the incidents and were implicated in 11.4 percent of the deaths. A comparative listing of the fire situations encountered in Arkansas and other states in Region II is provided in Table 8.4.

Additional insights with regard to Arkansas fire activity can be made by examining NFIRS data in terms of categories of fixed property use (see Table 8.5). In some states special properties—outdoor areas, construction sites, rail and roadways, and other similarly distinct sites—were the locations of the largest proportion of fires. This is not the case in Arkansas, where reports of residential fires outnumbered special property fires (32.9 percent vs. 29.3 percent respectively). As in other states, the effects of fires in Arkansas residential properties were particularly deadly; 81.8 percent of all deaths reported in NFIRS were attributable to residential fires.

ELEMENTS OF FIRE INCIDENCE

Further analysis of Arkansas' 1983 fire experience can be undertaken by using NFIRS data to examine three major causal elements of fire incidence: the equipment involved in a fire's ignition; the form of material initially ignited; and the factor of ignition. Table Arkansas-1 provides information about the involvement of these causal elements and a brief discussion of their implications for Arkansas.

TABLE ARKANSAS-1

CAUSAL ELEMENTS OF ARKANSAS FIRES

Equipment Involved in Ignition {1}	Fires	Deaths
—Heating Systems	10.4%	20.5%
—Cooking Equipment	6.1%	6.8%
—Electrical Distribution Equip't.	4.4%	2.3%
—Other/No Equipment	61.2%	50.0%

Form of Material Ignited {2}	Fires	Deaths
—Structural Framework	15.1%	22.8%
—Power Transformation	19.1%	20.5%
—General Form (Grass/Trash)	39.4%	0.0%
—Furniture/Soft Goods/Apparel	8.5%	27.3%

Ignition Factor	Fires	Deaths
—Misuse of Heat	18.0%	15.9%
—Mechanical Failure	4.7%	20.5%
—Operational Deficiency	8.1%	9.1%
—Arson	12.3%	6.8%

{Note 1} In 11.9% of all incidents, "Equipment Involved in Ignition" was either unknown or left blank.

{Note 2} In 6.7% of all incidents, "Form of Material Ignited" was either unknown or left blank.

In incidents where *equipment* was *involved in ignition*, heating systems, which represented 10.4 percent of the fires and 20.5 percent of the deaths, and cooking equipment, which was implicated in 6.1 percent of the fires and 6.8 percent of the deaths, had the highest proportion of involvement. As in other states, Arkansas fires were frequently ignited by other factors besides the principal categories of equipment. In 1983, 5,206 fires (61.2 percent of all NFIRS-reported incidents) were reportedly caused by other factors. Vehicles, for example, were implicated in the ignition of 28.4 percent of these fires. In 69.7 percent of these incidents, no equipment was involved. NFIRS analysts assume that these "no equipment" fires often have been ignited by the careless use of matches, lighters, and smoking materials; and 1,479 were started by vehicular involvement.

In Arkansas fires, the *forms of material* most frequently *ignited* were those in the so-called "general form" category; e.g., trees, grass, rubbish, and trash. These materials were identified as materials ignited in 39.4 percent of the state's incidents. Fortunately, fires involving general form materials had a low incidence of fatality. In 1983, Arkansas departments reported no known deaths resulting from this type of fire.

In turn, Arkansas fires which involved the ignition of power transformation materials had high rates of both incidence (19.0 percent) and deaths (20.5 percent). Another type of fire—where structural framework ignited—also occurred relatively frequently (15.0 percent) with deadly results (22.8 percent of all fire deaths).

[14]In 18.2 percent of the fire deaths reported to NFIRS, Arkansas respondents either did not identify or did not know the form of material ignited. Because of this, data findings may not be fully representational.

Ignition factors in Arkansas most often involved mechanical failure (24.7 percent of all incidents)—particularly in fires resulting from short circuits and part failure.[15] In 1983, 20.5 percent of the state's NFIRS-reported deaths were attributable to mechanical failure factors. Another leading factor was the misuse of heat of ignition (18.0 percent of the state's incidents). Open fires and abandoned materials were often involved in this type of incident.

CASUALTY SUMMARY

The risk of casualty from fire diminished slightly for Arkansas civilians between 1982 and 1983. In general, the number of casualties declined from 21.1 per 1,000 fires in 1982 to 18.8 in 1983. In terms of structure fires, the number of casualties decreased from 47.6 per 1,000 fires to 44.6 in 1983.

For state fire fighters, the risk of casualty declined more substantially. In 1982, 16.1 fire fighter casualties per 1,000 fires were reported compared to 12.0 in 1983. In terms of structure fires, the likelihood of casualty decreased from 36.3 casualties per 1,000 structure fires to 28.5 in 1983.

FLORIDA

In 1983, 267 (36.3 percent) of the 734 fire departments in Florida submitted data to the National Fire Incident Reporting System (NFIRS). During the year, departments reported 32,755 incidents from which 126 deaths (one involving a fire fighter) resulted. As in other states (See Table 8.4), the most common situations found are fires in structures (31.9 percent of all reported incidents), vehicles (27.2 percent), and in trees, brush, and grasslands (23.8 percent). Structure fires, which were implicated in 76.2 percent of the NFIRS-reported deaths, imposed a particularly troublesome element of the fire problem.

Through the analysis of NFIRS data, further insights can be made by looking at fire incidence categories of fixed property use. A comparative listing of Florida's fire activity and the experiences of other states in Region II is provided in Table 8.5. As this table indicates, the highest proportion of fires (46.6 percent) in Florida involved special property; e.g., construction sites, abandoned areas, roadways, and other similar areas. In 1983, 20.6 percent of the Florida deaths reported in NFIRS occurred as a result of special property fires. More deadly were Florida's residential fires, which represented 28.3 percent of all state incidents and 68.3 percent of all deaths in NFIRS.

ELEMENTS OF FIRE INCIDENCE

A more detailed analysis of Florida fire activity can be undertaken by using NFIRS data to examine three major elements of fire incidence: the equipment involved in a fire's ignition; the form of material first ignited; and the factors of ignition. Findings pertaining to these elements are provided in Table Florida-1 followed by a brief descriptive overview.

[15] In 23.8 percent of the Arkansas incidents and 38.6 percent of the NFIRS-reported deaths, ignition factors were unknown or unclassified. As a result, findings pertaining to these data may not be fully representational.

TABLE FLORIDA-1

CAUSAL FACTORS OF FLORIDA FIRES

Equipment Involved in Ignition {1}	**Fires**	**Deaths**
—Heating Systems	3.1%	4.8%
—Cooking Equipment	7.9%	7.1%
—Electrical Distribution Equip.'t.	5.6%	5.6%
—Other/No Equipment	57.3%	52.4%

Form of Material Ignited {2}	**Fires**	**Deaths**
—Structural Framework	7.0%	6.3%
—Power Transformation	21.1%	27.0%
—General Form	38.5%	3.2%
—Furniture/Bedding/Apparel	9.5%	28.6%

Ignition Factor {3}	**Fires**	**Deaths**
—Misuse of Heat	13.2%	20.6%
—Mechanical Failure	24.7%	9.5%
—Operational Deficiency	7.2%	13.5%
—Arson (Incendiary/Suspicious)	14.7%	18.3%

{Note 1} In 18.4% of all incidents, "Equipment Involved in Ignition" was either unknown or left blank.

{Note 2} In 9.5% of all incidents, "Form of Material Ignited" was either unknown or left blank.

{Note 3} In 27.6% of all incidents, "Ignition Factor" was either unknown or left blank.

There are eight primary categories of *equipment involved in the ignition* of fires: heating systems; cooking equipment; air conditioning; electrical distribution equipment; appliances; special equipment; processing equipment and service equipment. However, NFIRS data suggests that in most circumstances other factors, beyond these principal types of equipment, are involved in ignition. Florida's experience is in keeping with national and regional trends. In 1983, 57.3 percent of all NFIRS incidents and 52.4 percent of all reported deaths were caused by fires where other types of equipment; e.g., vehicles or no equipment was involved.[16] In the latter case, fire analysts have speculated that many of these fires were caused by the ignition of matches, lighters, and other cigarette-smoking materials.

The principal *forms of material ignited* in Florida fires are trees, grass, rubbish, and trash (known as general form materials). In 1983, about 38.5 percent of the state's fires involved this category of materials.[17] Fires where general form materials ignite are

[16]In 18.4 percent of the incidents reported in NFIRS and 24.4 percent of the deaths, the equipment involved in ignition was unclassified or unknown. As a result, findings pertaining to this causal element may not be fully representational.

[17]In 9.5 percent of the NFIRS incidents and 15.1 percent of the reported deaths, the form of material igniting the fire was not identified. As a result, findings pertaining to this causal element may not be fully representational.

inclined to have a low incidence of casualty. Florida's experience corresponds with this trend: only 3.2 percent of the state's deaths reported in NFIRS resulted from fires involving general form materials. In turn, fires where power transformation equipment or fuel were ignited, which represented 21.1 percent of all incidents, had one of the highest rates of fire death—27.0 percent. More deadly, but considerably less frequent, were fires involving furniture, soft goods, and apparel. In Florida, these fires, which constituted 9.5 percent of all incidents, were implicated in more deaths than any other category (28.9 percent).

The principal *ignition factor* in Florida fires during 1983 was mechanical failure, which was involved in 24.7 percent of the NFIRS-reported incidents.[18] Fortunately, such fires had a fairly low death rate—9.5 percent of the state's NFIRS-reported deaths. The highest proportion of deaths in Florida occurred in fires where the heat of ignition was misused—particularly when abandoned materials were involved. These fires, which represented 13.2 percent of the state's incidents, were implicated in 20.6 percent of Florida's NFIRS-reported deaths. This proportion is higher than the average for Region II states (16.5 percent) but lower than the national average (25.8 percent). Another ignition factor—arson—also maintained a higher proportion in Florida (14.7 percent of the incidents and 18.3 percent of the deaths) than the regional average (14.3 percent of the incidents and 11.8 percent of the deaths). Florida's arson-related deaths also had a higher proportion than the national average (13.9 percent) but incendiary and suspicious fires had a lower rate of incidence than the nation (17.3 percent).

CASUALTY SUMMARY

Casualty reports have increased slightly during the past several years in Florida. Among the state's civilian population, the general risk of casualty per 1,000 fires increased from 29.1 in 1982 to 32.0 in 1983. In terms of risk from structure fires, the number of casualties among civilians increased from 97.4 per 1,000 structure fires in 1982 to 100.0 in 1983.

Among fire fighters, a similar pattern is evident. The general level of incidence increased from 14.6 casualties per 1,000 fires in 1982 to 16.5 in 1983. In terms of risk from structure fires, the number increased from 48.9 casualties per 1,000 structure fires in 1982 to 51.5 in 1983.

LOUISIANA

Close to four-fifths (79.5 percent) of the 444 fire departments in Louisiana participated in the National Fire Incident Reporting System (NFIRS) during 1983. The U.S. Fire Administration commends Louisiana fire departments for this high rate of responsiveness to NFIRS. Their efforts have assisted in the strengthening of the NFIRS data base.

In 1983, a total of 16,404 incidents and 108 deaths (106 among civilians and 2 among fire fighters) were reported. From these fires, 376 injuries among civilians and 327 among fire fighters were reported. Based on NFIRS data, Louisiana had a slightly higher proportion of structure fires (46.0 percent) than the averages for Region II (41.3 percent)

[18] In 27.6 percent of the incidents reported in NFIRS and 27.0 percent of the deaths, the factors of ignition were either unknown or unclassified. Data findings pertaining to this causal element may not be fully representational.

and the nation (35.8 percent). Louisiana's structure incidents were implicated in 77.8 percent of the NFIRS-reported fire deaths: 82 civilians and 2 fire fighters died from the effects of these fires. Other principal fire situations found during 1983 were vehicle fires (representing 25.0 percent of the state's incidents and 20.4 percent of the deaths); fires in trees, brush, and grasslands (the site of 15.5 percent of the incidents), and refuse fires (10.6 percent of the incidents). A comparative listing of fire situations in Louisiana and other states in Region II is presented in Table 8.4.

An examination of fire incidence by categories of fixed property use indicates that Louisiana's fire activity is generally similar to the experiences of the region and the nation (See Table 8.5). However, in 1983, Louisiana fire departments did report a higher incidence of residential fires (42.0 percent of all fires) than the averages for the region (36.1 percent) and the nation (30.3 percent). The proportion of deaths attributed to residential fires was 75.9 percent, slightly higher than that of Region II (75.1 percent) and of the nation (72.6 percent).

ELEMENTS OF FIRE INCIDENCE

A more comprehensive analysis of fire activity in Louisiana can be undertaken by using NFIRS data to examine three major causal elements of the fire problem: the equipment involved in a fire's ignition; the form of material first ignited; and the factors of ignition. Table Louisiana-1 presents findings about these causal factors in Louisiana. A brief discussion of key components of these findings follows.

TABLE LOUISIANA-1

CAUSAL ELEMENTS OF LOUISIANA FIRES

Equipment Involved in Ignition {1}	**Fires**	**Deaths**
—Heating Systems	5.7%	7.4%
—Cooking Equipment	6.8%	5.5%
—Electrical Distribution Equip't.	6.5%	2.8%
—Other/No Equipment	57.1%	35.2%
Form of Material Ignited {2}	**Fires**	**Deaths**
—Structural Framework	13.0%	7.4%
—Power Transformation	18.4%	8.3%
—General Form (Grass/Trash)	27.9%	1.9%
—Furniture/Soft Goods	8.5%	10.2%
—Special Form	4.0%	5.5%
Ignition Factor {3}	**Fires**	**Deaths**
—Misuse of Heat	11.9%	10.2%
—Mechanical Failure	23.1%	5.5%
—Operational Deficiency	8.7%	15.7%
—Misuse of Material	5.4%	4.6%
—Arson (Incendiary/Suspicious)	10.5%	5.5%

{Note 1} In 17.0% of all incidents, "Equipment Involved in Ignition" was either unknown or left blank.

{Note 2} In 16.6% of all incidents, "Form of Material Ignited" was either unknown or left blank.

{Note 3} In 31.4% of all incidents, "Ignition Factor" was either unknown or left blank.

In fires where *equipment was involved in ignition*, the highest proportions of incidence were cooking equipment (6.8 percent); electrical distribution equipment (6.5 percent); and heating systems (5.7 percent).[19] Of these categories, fires started by heating systems were implicated in the largest percentage of deaths—7.4 percent. In over half (57.1 percent) of the Louisiana incidents, major categories of equipment had no involvement in ignition. Fires of this nature were often ignited by vehicular involvement or, even more commonly, by no equipment (e.g., matches, lighters, and other similar sources of ignition). In Louisiana, 35.2 percent of the NFIRS-reported fire deaths were attributed to incidents where fires were ignited by other equipment or "equipment-less" factors.

During 1983, the principal *forms of material ignited* were trees, grass, rubbish, and trash—known in the trade as "general form" materials.[20] Fires involving these materials represented 27.9 percent of the state's NFIRS incidents, a proportion lower than the average for the region (37.5 percent) and the nation (37.7 percent). Typified by a relatively low rate of casualty, in Louisiana, these fires accounted for only 1.9 percent of the fire deaths reported in NFIRS. Far more deadly were fires involving structural composition or finish, which represented 13.0 percent of the state's NFIRS incidents and 21.3 percent of the deaths. Fires of this nature commanded a higher proportion of incidence and resulted in a larger percentage of deaths than the region (9.9 percent and 15.9 percent respectively) and the nation (8.6 percent and 12.7 percent).

In terms of general incidence, mechanical failure was the leading *ignition factor* in Louisiana fires (23.1 percent of NFIRS-reported incidents).[21] Occurring less frequently, but more deadly in their effects, were fires involving operational deficiencies, which were implicated in 8.7 percent of the NFIRS incidents and 15.7 percent of the deaths.

CASUALTY SUMMARY

Reported fire casualties decreased in Louisiana during the past several years. Among the state's civilian population, the amount of general risk declined from 35.3 casualties per 1,000 fires in 1982 to 33.1 in 1983. In terms of structure fires, the number was reduced from 70.9 per 1,000 structure fires in 1982 to 59.7 in 1983.

Among fire fighters, the number of casualties reported declined from 14.4 per 1,000 fires in 1982 to 11.9 in 1983. Looking only at structure fires, the level of risk decreased from 29.0 casualties per 1,000 fires to 21.5 in 1983.

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[19]In 17.0 percent of the NFIRS-reported incidents and 45.4 percent of the deaths, equipment involvement was either unknown or unidentified. As a result findings pertaining to this causal element may not be fully representational.

[20]Data pertaining to material forms of ignition in Louisiana may not be fully representational. In 16.6 percent of the incidents and 43.5 percent of the deaths, material forms were either unknown or unclassified by Louisiana fire departments.

[21]Findings pertaining to factors of ignition may not be fully representational due to the large proportion of unknown or unclassified data (involving 31.4 percent of all incidents and 55.6 percent of all deaths).

SOUTH CAROLINA

Only twelve (2.6 percent) of the 450 registered fire departments in South Carolina submitted data to the National Fire Incident Reporting System (NFIRS) in 1983. Based on their reports, 1,083 total incidents took place during the year. Four deaths (none among fire fighters) and thirteen injuries (seven involving fire fighters) were reported by these participating departments. As in other states, the focal point of South Carolina's fire problem are incidents involving structures (30.7 percent of all NFIRS incidents and 100.0 percent of the fire deaths). However, as Table 8.4 indicates, South Carolina experienced a lower proportion of structure fires than the averages of both Region II (41.3 percent) and the nation (35.8 percent).

Looking at fire incidence by categories of fixed property use (see Table 8.5) indicates that South Carolina's highest proportion of fires (41.4 percent) involved special property; e.g., vacant or abandoned areas, construction sites, rail and roadways. One of the four deaths reported in NFIRS resulted from a special property fire. The remaining three deaths all occurred from residential fires, which represented 27.7 percent of all NFIRS incidents. South Carolina had a lower incidence of residential fires than the averages for the region (36.0 percent) and the nation (30.3 percent).[22]

ELEMENTS OF FIRE INCIDENCE

Further analysis of South Carolina's fire activity can be conducted by using NFIRS data to examine three major causal elements of fire incidence: the equipment involved in the ignition of fires; the form of material first ignited; and the ignition factor. A summary of these findings is presented in Table South Carolina-1 followed by a brief descriptive overview.

TABLE SOUTH CAROLINA-1

CAUSAL FACTORS OF SOUTH CAROLINA FIRES

Equipment Involved in Ignition {1}	**Fires**	**Deaths**
—Heating Systems	4.6%	50.0%
—Cooking Equipment	5.2%	0.0
—Electrical Distribution Equip't.	3.3%	0.0
—Other/No Equipment	46.2%	25.0%
Form of Material Ignited {2}	**Fires**	**Deaths**
—Structural Framework	8.3%	0.0%
—Power Transformation	17.3%	0.0
—General Form	33.3%	0.0
—Furniture/Soft Goods/Apparel	9.0%	75.0%
Ignition Factor {3}	**Fires**	**Deaths**
—Misuse of Heat	15.8%	75.0%
—Mechanical Failure	22.4%	0.0
—Operational Deficiency	7.0%	0.0
—Arson (Incendiary/Suspicious)	7.2%	0.0

[22]In 18.1 percent of the NFIRS incidents, the category of fixed property use where the fire occurred was either not known or not classified. As a result, these findings may not be fully representational.

{Note 1} In 35.8% of all incidents, "Equipment Involved in Ignition" was either unknown or left blank.

{Note 2} In 13.2% of all incidents, "Form of Material Ignited" was either unknown or left blank.

{Note 3} In 32.5% of all incidents, "Ignition Factor" was either unknown or left blank.

As Table South Carolina-1 indicates, standard categories of *equipment* frequently were not *involved in the ignition* of state fires. More commonly, other factors—such as vehicular involvement—are at hand in ignition. Nearly one-half (46.2 percent) of South Carolina's NFIRS-reported fires fell in this classification. In many of these instances, such fires are ignited by "equipment-less" factors. Analysts speculate that many of these fires are started by matches, lighters, and careless smoking materials. In fires where equipment involvement was identified, cooking equipment—principally stove tops—was the leading source of ignition (5.2 percent of NFIRS incidents in South Carolina). Another source, heating systems, represented 4.6 percent of the incidents in South Carolina and 50.0 percent of the deaths.[23]

As in other states, so-called "general form" materials were the most frequent *forms of material ignited* in South Carolina. These fires, where trees and grass (20.7 percent) and rubbish and trash (7.8 percent) were principally ignited, collectively accounted for 33.3 percent of the NFIRS incidents reported in South Carolina. Less frequent, but more of a threat to human life, were fires involving furniture, soft goods and apparel (9.0 percent). Such fires, often igniting upholstery or bedding, were implicated in 75.0 percent of the state's NFIRS-reported deaths.[24]

In terms of general incidence, the leading *ignition factor* in South Carolina fires was mechanical failure, which accounted for 22.4 percent of the state's NFIRS fires. Fires involving misuse of heat of ignition were slightly less frequent (15.8 percent), but had much more frightening effects (75.0 percent) of all NFIRS-reported deaths.[25]

CASUALTY SUMMARY

For civilians, the general level of risk from South Carolina fires was 9.2 casualties per 1,000 fires in 1983. Looking only at structure fires, the number was 30.0 per 1,000 structure fires.

Among fire fighters, the amount of casualties was 6.5 per 1,000 fires. In terms of structure fires, the number was 21.0 casualties per 1,000 structure fires.

There were no comparative data available for 1982.

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[23]In 35.6 percent of the NFIRS incidents and 25.0 percent of the deaths, the equipment involved in ignition was either unknown or unclassified by South Carolina respondents. As a result, the accuracy of findings pertaining to equipment involvement may be limited.

[24]In 13.1 percent of the incidents reported and 25 percent of the deaths, the form of material ignited was either not known or not classified. Hence, findings pertaining to this topic may not be fully representational.

[25]In 32.4 percent of the NFIRS incidents and 25.0 percent of the deaths, the ignition factor was either not known or not identified by South Carolina respondents. Because of this comparatively large proportion of unclassified data, the accuracy of these findings is in question.

TENNESSEE

Ninety-nine (24.8 percent) of Tennessee's 400 registered fire departments participated in the National Fire Incident Reporting System during 1983. During 1983, a total of 8,706 fire incidents and 50 fire deaths were reported to NFIRS from the 99 participating fire departments in Tennessee. One-hundred-one fire fighter injuries were reported and 94 among civilians.[26] As in other states, the nucleus of Tennessee's fire problem is found in structure fires (42.6 percent of all NFIRS incidents and 76.0 percent of all deaths). Also of critical importance are fires located in trees, brush, grasslands (22.7 percent of incidence) and vehicles (21.7 percent of incidence and 22.0 percent of deaths). A complete listing of fire situations found in Tennessee and other states in Region II during 1983 is presented in Table 8.4.

In terms of fixed property use, NFIRS data indicate that Tennessee fires most often occur in categories of special property; e.g., abandoned property, construction sites, rail and roadways. During 1983, 39.4 percent of all fires and 22.0 percent of all deaths reported took place in this special property designation. Only slightly less frequent and far more deadly are residential fires, which represented 38.4 percent of Tennessee's fires and 74.0 percent of the NFIRS-reported deaths (See Table 8.5).

ELEMENTS OF FIRE INCIDENCE

A better understanding of Tennessee's fire problem can be achieved by using NFIRS data to examine three major elements of fire incidence: the equipment involved in a fire's ignition; the form of material first ignited; and the ignition factor. A summary of this information is provided in Table Tennessee-1 followed by a brief descriptive overview.

TABLE TENNESSEE-1

CAUSAL FACTORS OF TENNESSEE FIRES

Equipment Involved in Ignition {1}	**Fires**	**Deaths**
—Heating Systems	11.5%	8.0%
—Cooking Equipment	5.5%	0.0
—Electrical Distribution Equip't.	5.1%	8.0%
—Other/No Equipment	53.6%	56.0%
Form of Material Ignited {2}	**Fires**	**Deaths**
—Structural Framework	12.4%	16.0%
—Power Transformation	18.0%	12.0%
—General Form (Grass/Trash)	33.7%	0.0
—Furniture/Soft Goods/Apparel	6.5%	30.0%
Ignition Factor {3}	**Fires**	**Deaths**
—Misuse of Heat	17.3%	6.0%
—Mechanical Failure	23.9%	20.0%
—Operational Deficiency	9.0%	8.0%
—Arson (Incendiary/Suspicious)	9.4%	6.0%

{Note 1} In 19.2% of all incidents, "Equipment Involved in Ignition" was either unknown or left blank.

[26]NFIRS analysts speculate that injuries—particularly among civilians—are substantially under-reported.

{Note 2} In 14.6% of all incidents, "Form of Material Ignited" was either unknown or left blank.

{Note 3} In 25.9% of all incidents, "Ignition Factor" was either unknown or left blank.

According to NFIRS data, the *equipment involved in ignition* in Tennessee fires most frequently are heating systems (implicated in 11.5 percent of the fires and 8.0 percent of the deaths).[27] However, in keeping with national and regional patterns, more often than not other factors besides equipment—vehicular involvement, for example—are implicated in ignition. In Tennessee, during 1983, 53.6 percent of all NFIRS-reported fires and 56.0 percent of the deaths fell in this category. In 42.5 percent of these instances, equipment had absolutely no involvement. Analysts attribute ignition sources from such fires to be due to matches, lighters, and other similar materials commonly used by tobacco smokers.

The principal *forms of material ignited* in Tennessee fires are trees, grass, rubbish, and trash—known as general form materials.[28] During 1983, 33.7 percent of the incidents reported in Tennessee involved general form materials. No deaths were reported from these fires. Fires that resulted in substantially higher proportions of death involved the ignition of furniture, soft goods, and apparel. Tennessee's death rate from these fires—30.0 percent—was higher than the regional (26.2 percent) and national (29.3 percent) averages. Fortunately, these fires did not occur frequently (6.5 percent).

In Tennessee, the *factor of ignition* most often implicated in fire deaths was also the one involved in the largest proportion of incidents.[29] Fires started by mechanical failure represented 23.9 percent of all NFIRS incidents and 20.0 percent of all deaths. Another deadly ignition factor in Tennessee fires was misuse of heat—particularly in fires involving abandoned materials. This category of ignition factor was implicated in 17.3 percent of the NFIRS incident and 18.0 percent of the deaths. Arson-related fires were considerably lower in proportions of incidence (9.4 percent) and deaths (6.0 percent) when compared to regional (14.3 percent, 13.0 percent respectively) and national (17.3 percent, and 13.9 percent) averages.

CASUALTY SUMMARY

The likelihood of undergoing a casualty—death or injury—from a fire in Tennessee increased slightly. For civilians, the general level of casualty increased from 15.4 per 1,000 fires in 1982 to 16.5 casualties in 1983. In terms of structure fires, the number of casualties among civilians rose from 37.1 per 1,000 structure fires to 38.8 in 1983.

Among fire fighters, the number of casualties increased from 9.9 per 1,000 fires in 1982 to 11.6 in 1983. Looking only at structure fires, the amount of casualties increased from 23.7 per 1,000 fires in 1982 to 27.2 in 1983.

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[27] In 19.2 percent of the incidents, the equipment involved in ignition was either unknown or unclassified. As a result, these data findings may not be fully representational.

[28] In 14.6 percent of the Tennessee incidents and 32.0 percent of the fire deaths, the form of material ignited was either not known or not identified. As a result, findings pertaining to this data base may be of limited accuracy.

[29] In 25.9 percent of the NFIRS incidents reported in Tennessee involving 46.0 percent of the deaths, the ignition factor was either not known or not identified. Because of this large proportion of unclassified data, the accuracy of these findings is somewhat questionable.

VIRGINIA

Only about one-fifth (16.9 percent) of the 702 fire departments in Virginia submitted reports to the National Fire Incident Reporting System during 1983. As a result, the data contained in this section may not be representational and the accuracy of findings pertaining to the state's fire experience may be impaired. Readers are advised to bear this in mind during the course of their review of this section.

In 1983, Virginia fire departments reported the occurrence of 11,164 incidents. These incidents, according to NFIRS data, resulted in a total of 50 civilian deaths (none were reported among fire fighters). Injury tallies from these fires totaled 444—238 among civilians and 206 among fire fighters.

As in other states, the heart of Virginia's 1983 fire problem was found in its structure fires, which represented 45.9 percent of all NFIRS-reported incidents and 84.0 percent of all deaths. Other types of fires having a large proportion of incidence were those in vehicles (20.5 percent), trees, brush, grasslands (collectively representing 16.5 percent of all reported fires), and refuse (12.5 percent). A list of fire situations found in Virginia and other states in Region II is provided in Table 8.4.

A look at fire incidence by categories of fixed property use indicates that Virginia's experience generally corresponds with other states in Region II (See Table 8.5). However, Virginia departments did report a higher proportional incidence of residential fires (42.9 percent) than regional (36.0 percent) and national (30.3 percent) averages. Fortunately, the death rate from residential fires was only slightly higher (78.0 percent) than that of the region (75.1 percent) and nation (72.6 percent).

ELEMENTS OF FIRE INCIDENCE

A more detailed analysis of Virginia fire activity can be accomplished by using NFIRS data to examine three major causal elements of fire incidence. Findings pertaining to these components are summarized in Table Virginia-1 and are followed by a brief descriptive overview.

TABLE VIRGINIA-1

CAUSAL FACTORS OF VIRGINIA FIRES

Equipment Involved in Ignition {1}	Fires	Deaths
—Heating Systems	20.2%	12.0%
—Cooking Equipment	5.6%	2.0%
—Electrical Distribution Equipment	4.6%	0.0
—Other/No Equipment	50.6%	18.0%

Form of Material Ignited {2}	Fires	Deaths
—Structural Framework	9.1%	12.0%
—Power Transformation	18.2%	12.0%
—General Form (Grass, Trash)	45.9%	2.0%
—Furniture/Soft Goods	9.0%	24.0%

Ignition Factor {3}	Fires	Deaths
—Misuse of Heat	20.4%	12.0%
—Mechanical Failure	22.8%	10.0%
—Operational Deficiency	17.8%	22.0%
—Misuse of Material Ignited	4.8%	16.0%
—Arson (Incendiary, Suspicious)	13.6%	20.0%

{Note 1} In 10.3% of all incidents, "Equipment Involved in Ignition" was either unknown or left blank.

{Note 2} In 6.4% of all incidents, "Form of Material Ignited" was either unknown or left blank.

{Note 3} In 13.6% of all incidents, "Ignition Factor" was either unknown or left blank.

As Table Virginia-1 indicates, in the majority of the state's fires, other factors besides the standard categories of *equipment* were *involved in ignition.* A little over one-half (50.6 percent) of the incidents fell in this category.[30] Some of these fires were started by vehicular involvement (9.5 percent of the incidents reports). More often, however, no equipment was involved (40.0 percent). Analysts speculate that fires ignited out equipment involvement are often caused by careless smoking; ignition in these instances occurs from matches, lighters, and other smoking-materials. In Virginia fires where standard types of equipment were involved, most frequently heating systems were the source of ignition (20.2 percent).

The principal *forms of materials ignited* in Virginia fires during 1983 were trees, grass, rubbish, and trash (known as "general form" materials). Fires where these materials burned accounted for 45.9 percent of all NFIRS-reported incidents. General form fires are inclined to have a comparatively low rate of casualty: in Virginia, one death was reported from such fires. As Table Virginia-1 indicates, furniture, soft goods, and apparel fires were considerably less common (9.0 percent of NFIRS incidents), but much more deadly (24.0 percent of all NFIRS-reported deaths).

[30]In 10.3 percent of the incidents and 18.0 percent of the deaths, the equipment involved in ignition was either unidentified or unknown by Virginia NFIRS respondents. As a result findings pertaining to this data may not be fully representational.

In Virginia fires, the *ignition factor*, which had the highest proportion of frequency, was mechanical failure, which represented 22.8 percent of all incidents.[31] Fires which had the largest proportion of deaths were those that ignited as a result of operational deficiencies (22.0 percent of all deaths). Arson-related fires also were implicated in a comparatively large proportion of deaths (20.0 percent).

CASUALTY SUMMARY

For the most part, the risk of casualty from Virginia fires declined slightly during the past few years. However, among civilians, the general number increased from 32.5 casualties per 1,000 fires in 1982 to 35.9 in 1983. Looking only at structure fires, the number of injured or dead fire fighters declined from 33.6 per 1,000 structure fires to 26.3 in 1983.

WEST VIRGINIA

West Virginia is to be commended for its active participation in the National Fire Incident Reporting System (NFIRS). Over ninety percent (95.7) of the state's 422 registered fire departments submitted NFIRS reports during 1983. The nearly complete range of this data provides greater assurance that findings contained in this analysis are representational of fire activity in both the state and region.

During 1983, West Virginia fire departments reported the incidence of 8,576 fires. From these incidents there were 59 recorded deaths (including one fire fighter victim) and an estimated 236 injuries (105 among fire fighters). Based on NFIRS reports, West Virginia had an unusually high incidence of structure fires (60.5 percent of all NFIRS incidents) compared to regional (41.3 percent) and national (35.8 percent) averages. Deaths from structure fires in West Virginia (87.7 percent) were also in higher proportions than the region (79.6 percent) and the nation (77.6 percent). A comparative listing of fire situations in West Virginia and other states in Region II is provided in Table 8.4.

Analysis of West Virginia's fire activity by categories of fixed property use reveals that incidents involving residential property were a particularly troublesome component of the state's fire problem. In 1983, 47.4 percent of the state's NFIRS incidents took place in residential properties. More critically, these fires were implicated in 81.4 percent of the NFIRS-reported deaths—a proportion higher than that of the region (75.1 percent) and the nation (72.6 percent). Additional information pertaining to West Virginia fire incidence by fixed property use is provided in Table 8.5

ELEMENTS OF FIRE INCIDENCE

Further analysis of 1983 fire activity can be undertaken by using NFIRS data to examine three major causal elements of fire incidence: the equipment involved in fire ignition; the form of material first ignited; and the ignition factors. A summary of these findings as they relate to West Virginia is provided in Table West Virginia-1 and is followed by a brief, descriptive overview.

[31]In 13.6 percent of the NFIRS incidents and 20.0 percent of the deaths, ignition factors were either unknown or unclassified. As a result, these data findings may not be fully representational.

TABLE WEST VIRGINIA-1

CAUSAL FACTORS OF WEST VIRGINIA FIRES

Equipment Involved in Ignition {1}	**Fires**	**Deaths**
—Heating Systems	20.5%	28.8%
—Cooking Equipment	3.8%	1.7%
—Electrical Distribution Equipment	8.2%	5.1%
—Other/No Equipment	49.3%	44.1%

Form of Material Ignited {2}	**Fires**	**Deaths**
—Structural Framework	23.5%	27.1%
—Power Transformation	1.7%	23.7%
—General Form (Grass, Trash)	30.9%	0.0
—Furniture/Soft Goods/Apparel	7.2%	13.6%
—Special Form	3.1%	11.9%

Ignition Factor {3}	**Fires**	**Deaths**
—Misuse of Heat	9.7%	13.6%
—Mechanical Failure	24.0%	27.1%
—Operational Deficiency	16.3%	18.6%
—Arson (Incendiary, Suspicious)	13.6%	11.9%
—Misuse of Material	3.2%	6.8%

{Note 1} In 12.7% of all incidents, "Equipment Involved in Ignition" was either unknown or left blank.

{Note 2} In 11.9% of all incidents, "Form of Material Ignited" was either unknown or left blank.

{Note 3} In 22.8% of all incidents, "Ignition Factor" was either unknown or left blank.

In most West Virginia incidents, as in other states, standard categories of *equipment* often are not *involved in ignition*.[32] During 1983, 49.3 percent of the fires and 44.1 percent of the deaths reported to NFIRS were ones involving other sources of ignition. In 35.6 percent of these incidents, no equipment was involved in ignition: frequently, these types of fires begin by careless use of matches, lighters, and other smoking materials. Another 12.1 percent of these incidents were ignited by vehicular involvement. In fires where equipment was involved in ignition, heating systems had the highest proportion of occurrence (20.5 percent of NFIRS incidents) and were implicated in the most fire deaths (28.8 percent). This rate of incidence and deaths by heating systems fires—principally from fixed heaters and fire places—was considerably higher than that of the region and the nation.

[32]In 12.7 percent of the incidents and 16.9 percent of the deaths, equipment involvement was either unidentified or unknown by West Virginia NFIRS respondents. As a result, findings pertaining to this topic may not be fully representational.

In West Virginia, "general form" materials—trees, grass, rubbish, trash—are the most common *form of materials ignited.*[33] General form fires accounted for 30.9 percent of the state's NFIRS incidents fires. No deaths were reported in this category. Fires involving structural composition and finish also had a relatively high rate of incidence (23.5 percent) and, more importantly, were implicated in the largest proportion of deaths (27.1 percent).

The leading *ignition factor* in West Virginia fires was mechanical failure—implicated in 24.0 percent of the state's incidents and 27.1 percent of the deaths.[34] Second ranking in terms of both incidence (16.3 percent) and deaths (18.6 percent) were fires involving operational deficiencies.

CASUALTY SUMMARY

The risk of casualty from West Virginia fires increased some in the past few years. For civilians, the general number rose from 13.7 casualties per 1,000 fires in 1982 to 22.0 in 1983. In terms of structure fires, the amount increased form 25.8 per 1,000 structure fires in 1982 to 36.4 in 1983.

For fire fighters, the amount of risk increased only slightly. In 1982, the general level of casualties per 1,000 fires was 10.7; in 1983, the number increased in 12.4. Looking only at structure fires, the level remained relatively stable, rising only from 20.2 casualties per 1,000 structure fires in 1982 to 20.4 in 1982.

FIRE ACTIVITY IN REGION III

The midwestern states of the nation constitute Region III of the National Fire Incident Reporting System (NFIRS). In 1983, eight states participated in NFIRS: Illinois, Iowa, Kansas, Michigan, Minnesota, Ohio, South Dakota, and Wisconsin. In Nebraska, the fire departments of only one municipality—Lincoln—submitted data to NFIRS. Because of this, Nebraska has been excluded from this analysis. Three remaining states in the region—North Dakota, Indiana and Missouri—did not participate in NFIRS, and, hence, are not included in this analysis.

The level of participation in NFIRS varies from state to state which, to some extent, may affect the accuracy of the data findings of any regional analysis. For example, only 24.6 percent of the fire departments in Kansas submitted NFIRS data in contrast to Michigan where 82.2 percent of the registered departments were NFIRS participants. Of the 6,675 fire departments registered in these eight states, 4,445—59.9 percent—submitted data to NFIRS. While the proportion of data responses is larger than in some regions, readers nonetheless are cautioned that the findings contained in this analysis may not be fully representational.

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[33]In 11.9 percent of the NFIRS incidents and 23.7 percent of the deaths, the form of material ignited was either unclassified or unknown by West Virginia respondents. As a result, findings pertaining to this topic may not be fully representational.

[34]In 22.8 percent of the state's NFIRS incidents and 16.8 percent of the deaths, the ignition factor was either unclassified or unknown by West Virginia respondents. Because of this, findings pertaining to this topic may not be fully representational.

1983 FIRE RECORD

During 1983, the eight participating states of Region III collectively reported a total of 232,430 incidents and 745 fire-related deaths to the National Fire Incident Reporting System. As in other areas of of the nation, dominant fire situations in Region III were structure fires, which accounted for 40.4 percent of the NFIRS incidents. Fire activity in this area was more frequent than for the nation as a whole (35.8 percent). So, too, was the regional incidence of deaths resulting from structure fires—85.4 percent compared to the national average of 77.6 percent. Vehicle fire situations in Region III (25.2 percent) were more in line with national experience (24.6 percent). And, vehicle-related fire deaths were smaller in proportion in the region (12.2 percent) than in the nation (19.0 percent). A state-by-state list of 1983 fire situations found in Region III compared the nation's average is provided in Table 8.7.

FIRE INCIDENCE IN REGION III BY SITUATION FOUND

States	*NFIRS* Fires	*NFIRS* Deaths	*Structure Fires* Fires%	*Structure Fires* Deaths%	*Vehicle Fires* Fires%	*Vehicle Fires* Deaths%	*Trees, Grass Brush Fires* Fires%	*Trees, Grass Brush Fires* Deaths%	*Refuse, Trash Fires* Fires%	*Refuse, Trash Fires* Death%	*Other Fires*[1] Fires%	*Other Fires*[1] Deaths%	*Unclassified* Fires%	*Unclassified* Deaths%
Illinois	38,400	103	35.6	81.6	27.3	16.5	18.3	—	14.7	—	4.1	1.9	—	—
Iowa	12,442	48	42.3	72.9	27.8	25.0	14.7	—	11.5	2.1	3.6	—	.1	—
Kansas	14,660	40	31.6	52.5	24.3	35.0	25.9	—	14.3	—	3.9	12.5	—	—
Michigan	70,140	192	39.2	88.5	23.1	8.9	15.8	—	18.5	—	3.3	2.6	.1	—
Minnesota	15,163	74	50.7	93.2	25.5	6.8	13.8	—	6.9	—	3.1	—	—	—
Ohio	64,433	222	41.7	93.2	27.0	5.9	13.1	.45	16.4	.45	1.8	—	—	—
South Dakota	3,126	19	35.4	63.2	23.1	26.3	25.4	10.5	6.2	—	9.9	—	—	—
Wisconsin	14,066	47	52.4	80.9	21.0	17.0	14.6	—	8.4	—	3.6	2.1	—	—
Region III Total	232,430	745	40.4	85.4	25.2	12.2	16.0	.4	15.1	.1	3.2	1.9	.1	—
U.S. Total	767,310	2,298	35.8	77.6	24.6	19.0	19.9	.9	15.8	.3	3.8	2.2	.05	—

[1]"Other" includes incidents found outside of structures, explosions, outside spills and leaks, and miscellaneous fires.

Table 8.7

An exploration of fire activity by fixed property use indicates that the largest proportion of incidents in Region III was in categories of special property (50.4 percent). While not uncommon, the rate of special property fires exceeded the national average (46.9 percent). However, the proportion of deaths resulting from special property fires (10.9 percent) was considerably lower than the U.S. average (19.1 percent). Residential fire incidence was in keeping with national experience—30.8 percent compared to 30.3 percent. Fires in residential properties were implicated in a larger proportion of deaths in Region III (79.6 percent) than the nation as a whole (72.6 percent). Of the four regions in NFIRS, Region III had the highest rate of fires involving commercial properties (11.0 percent compared to 9.7 percent for the nation as a whole). A complete list of regional fire activity by categories of fixed property use is provided in Table 8.8.

FIRE INCIDENTS IN REGION III BY FIXED PROPERTY USE

States	*NFIRS* Fires	*NFIRS* Deaths	*Public, Institutional Educational Property* Fires%	Deaths%	*Residential Property* Fires%	Deaths%	*Commercial, Office Industrial Storage Property* Fires%	Deaths%	*Special Property* Fires%	Deaths%	*Unclassified* Fires%	Deaths%
Illinois	38,400	103	4.1	1.9	30.6	78.6	11.4	3.9	43.5	9.7	10.4	5.8
Iowa	12,442	48	3.0	—	27.9	60.4	16.8	12.5	41.1	27.1	11.2	—
Kansas	14,660	40	3.4	—	31.0	55.0	13.0	10.0	42.7	30.0	9.9	5.0
Michigan	70,140	192	2.9	2.1	28.8	83.9	10.0	3.6	58.2	10.4	.1	—
Minnesota	15,165	74	4.0	—	38.1	87.8	14.3	2.7	41.8	6.8	1.8	2.7
Ohio	64,433	222	2.5	4.0	29.5	85.1	8.2	4.5	58.4	5.9	1.3	.5
South Dakota	3,126	19	2.6	—	27.3	57.9	18.8	5.3	25.1	21.0	26.8	15.8
Wisconsin	14,066	47	4.1	4.2	43.0	74.5	15.1	6.4	25.0	8.5	12.8	6.4
Region III	232,430	745	3.2	2.3	30.8	79.6	11.0	5.0	50.4	10.9	4.6	2.3
U.S.	767,310	2,298	3.7	1.4	30.3	72.6	9.7	4.6	46.9	19.1	9.3	2.2

Table 8.8

ELEMENTS OF FIRE INCIDENCE

Further analysis of regional fire activity can be undertaken by using NFIRS data to examine three major causal elements of fire activity: the equipment involved in a fire's ignition; the form of material first ignited; and the ignition factor. Table 8.9 summarizes regional data pertaining to these three elements and is followed by a brief descriptive overview. State by state reviews of causal factors in fire incidence are provided in subsequent sections of this regional analysis.

CAUSAL FACTORS OF REGION III FIRES

Equipment Involved in Ignition {1}	Fires	Deaths
—Heating Systems	9.0%	9.8%
—Cooking Equipment	4.6%	5.4%
—Electrical Distribution Equipt.	4.3%	6.4%
—Other Remaining Categories of Equipt.	6.3%	4.7%
—No Equipt./Vehicle/Non-Standard Equipt.	48.9%	43.8%
—Unknown/Blank/Invalid Responses	26.9%	29.9%
Total	100.0%	100.0%

Form of Material Ignited	Fires	Deaths
—Structural Framework	9.8%	10.9%
—Power Transformation	19.5%	13.3%
—General Form (Grass/Trash)	38.2%	8.2%
—Furniture/Soft Goods/Apparel	8.4%	30.7%
—Other Remaining Categories	12.4%	13.5%
—Unknown/Blank/Invalid Responses	11.7%	24.0%
Total	100.0%	100.0%

Ignition Factor	Fires	Deaths
—Misuse of Heat	18.0%	31.8%
—Mechanical Failure	23.2%	9.8%
—Operational Deficiency	8.5%	10.6%
—Misuse of Material	5.9%	8.3%
—Arson (Incendiary/Suspicious)	13.9%	9.4%
—Other Remaining Categories	7.4%	2.7%
—Unknown/Blank/Invalid Responses	23.1%	27.4%
Total	100.0%	100.0%

Table 8.9

As the preceding table indicates, analysis of causal elements in fire incidence is marred somewhat by a high proportion of unknown, invalid, and blank responses. Looking at equipment involved in ignition in Region III fires, for example, reveals that in 26.9 percent of the NFIRS incidents and 29.9 percent of the reported deaths, equipment involvement was either not known or not identified by state department respondents. In light of this, it is important to emphasize that data findings contained in this section may not be fully representational of causal factors in Region III fires.

Of the standard equipment categories in NFIRS, three types of equipment—heating systems, cooking equipment, and electrical distribution equipment—tended to be involved in fire ignition. Of these, heating systems had the largest proportion of involvement in Region III. Heating systems were implicated in 9.0 percent of the region's NFIRS fires and 9.8 percent of the deaths. This reflected a slightly higher rate of incidence than the U.S. average (8.6 percent) but a smaller proportion of deaths (11.0 percent). In terms of incidence, the type of equipment having the second highest rate of involvement was cooking equipment, which represented 4.6 percent of the fires and 5.4 percent of the deaths. Fires involving electrical distribution equipment resulted in a slightly larger proportion of deaths (6.4 percent) but were a little less frequent (4.3

percent). Remaining standard categories of equipment collectively totaled 6.3 percent of the incidents and 4.7 percent of the deaths.[35]

As in other regions of the country, a large proportion of Region III fires ignited without standard equipment involvement (48.9 percent). Unfortunately, fires falling under this category typically are associated with a high incidence of death. In 1983, 43.8 percent of the region's NFIRS deaths resulted from such fires. Many of these fires were started by vehicle involvement and a few were ignited by non-standard types of equipment. However, a number of these fires were ignited out any equipment whatsoever. Fire analysts have speculated that many of the "no equipment" fires may be caused by the ignition of matches, lighters, and other smoking materials.

Not unlike other parts of the U.S. the most common *forms of material ignited* in Region III fires were trees, grass, trash, and other matter known as "general form" materials. In 1983, 38.2 percent of the fires in the region involved these materials. Less frequent but far more deadly were fires where furniture, soft goods, and apparel ignited. In Region III, fires involving these materials represented only 8.4 percent of the NFIRS incidents but 30.7 percent of the deaths. This was generally in keeping with the national average—8.6 percent of NFIRS incidents and 29.3 percent of the deaths. Fires involving structural framework were slightly more common in Region III (9.8 percent) compared to the nation as a whole (8.9 percent) but resulted in a considerably smaller rate of deaths (10.9 percent compared to 12.7 percent for the nation). In turn, power transformation fires were on a par with national experience (19.5 percent of the region's fires and 19.2 percent of the U.S. incidents). However, deaths from these fires were slightly more common in Region III (13.3 percent) than in the nation as a whole (12.8 percent).

In terms of general incidence, the leading *ignition factor* in Region III fires was mechanical failure, which accounted for 22.4 percent of the NFIRS fires and 10.8 percent of the reported deaths. This was generally commensurate with the national average (22.4 percent of the U.S. fires and 10.8 percent of the deaths). Fires started by the misuse of heat of ignition had a higher rate of incidence in Region III—18.0 percent—than in the nation as a whole—16.6 percent. More importantly, these fires resulted in a substantially higher proportion of deaths (31.8 percent in Region III compared to 25.8 percent in the U.S.). Arson-related fires occurred with less frequency in Region III (13.9 percent) than in the nation as a whole (17.3 percent) and had a considerably lower rate of deaths (9.4 percent compared to 13.9 percent for the nation).

SUMMARY

Region III constitutes a substantial portion of the National Fire Incident Reporting System. A little over 40 percent (41.8) of the 10,637 fire departments that participated in NFIRS during 1983 are based in this region. Because of its size and its relatively high level of NFIRS participation, findings pertaining to the fire activity of Region III are of particular significance.

Departments in Region III reported one of the highest proportions of structural fire incidence in the nation. Region III was second only to the southern United States (Region II) in terms of structural fire incidence and to the eastern United States (Region I) in terms of deaths resulting from structural fires. These high rates may be partially

[35]These proportions are derived from the following five equipment categories: air conditioning; appliances; special equipment; processing equipment; and service equipment.

explainable by the densely populated and older structures common in some urban areas of Region III.

In terms of fire incidence and fixed property use, Region III departments reported the second highest incidence of fires involving special property: slightly over half the region's NFIRS fires fell in this category. The rural nature of much of the Region III states accounts for special property fires which involve outdoor areas. A relatively high incidence of fires in roadway properties undoubtedly also contributed to the large proportion of fires in special property. Fortunately, Region III was below the national average in the proportion of deaths resulting from special property fires.

ILLINOIS

Illinois had a slightly higher than average rate of participation in the National Fire Incident Reporting System in 1983. During this period, 58.1 percent of the state's registered fire departments submitted data to NFIRS. This comparatively large proportion of participation has helped to strengthen the overall quality of the NFIRS data base. The U.S. Fire Administration commends Illinois departments for their response and looks forward to even higher levels of participation in future years.

In 1983, 38,400 incidents were reported in Illinois by 728 of the state's 1,253 total fire departments. Of the reports submitted, 103 fire deaths were recorded: 101 took place among civilians and two among Illinois fire fighters.

As in other states (See Table 8.7), incidents most commonly reported were structure fires. However, of the Region III states, Illinois had one of the lower proportions of structure fire incidence—35.6 percent. Other substantial elements of the Illinois fire problem in 1983 were vehicle fires (27.3 percent); trees, grass, and brush fires (18.3 percent); and refuse fires (14.7 percent). Structure and vehicle fires were accountable for 98.1 percent of all reported fire deaths in Illinois in 1983.

In terms of fixed property use, Illinois fire experience is generally in keeping with regional activity (See Table 8.8) In 1983, 43.5 percent of all Illinois fires took place in special property (25.0 percent involving roadways and 10.4 percent involving grasslands). In turn, 30.6 percent of the reported fires and 78.6 percent of the deaths occurred in residential property.

ELEMENTS OF FIRE INCIDENCE

To further interpret Illinois fire activity, NFIRS data was used to analyze three major causal elements of fire incidence: the equipment involved in fire ignition; the form of material initially ignited by the fire; and the ignition factor. Table Illinois-1 summarizes the principal findings pertaining to this topic and is followed by a brief descriptive overview.

TABLE ILLINOIS-1

CAUSAL FACTORS OF ILLINOIS FIRES

Equipment Involved in Ignition {1}	**Fires**	**Deaths**
—Heating Systems	3.9%	2.9%
—Cooking Equipment	4.9%	2.9%
—Electrical Distribution Equip't.	4.0%	7.8%
—Appliances	2.2%	5.8%
—Other/No Equipment	63.9%	50.5%
Form of Material Ignited {2}	**Fires**	**Deaths**
—Structural Framework	9.8%	14.6%
—Power Transformation	19.3%	1.9%
—General Form (Grass, Trash)	35.0%	3.9%
—Furniture/Soft Goods/Apparel	8.5%	31.1%
Ignition Factors {3}	**Fires**	**Deaths**
—Misuse of Heat	15.3%	21.4%
—Mechanical Failure	23.1%	9.7%
—Operational Deficiency	6.1%	5.8%
—Arson (Incendiary, Suspicious)	15.4%	5.8%

{Note 1} In 17.5% of the incidents and 28.1% of the deaths, "Equipment Involved in Ignition" was either unknown or unclassified.

{Note 2} In 11.6% of the incidents and 34.0% of the deaths, "Form of Material Ignited" was either unknown or unclassified.

{Note 3} In 28.7% of the incidents and 48.5% of the deaths, "Ignition Factor" was either unknown or unclassified.

As the preceding table indicates, analysis of the first causal element—equipment *involved in ignition*—is limited by a substantial proportion (17.5 percent) of unknown or unclassified responses. In turn, in 28.1 percent of the fire deaths, information about the type of equipment involved is not known. Because of this relatively high proportion of blank responses, findings pertaining to equipment involvement may not be fully representational. In fires where equipment involvement was identified by Illinois NFIRS respondents, cooking equipment had the largest proportion of involvement (4.9 percent).

As in other states, a sizable proportion of fires ignited *without* the involvement of standard types of equipment. Over 60 percent (63.9) of the incidents and over half of the deaths (50.5 percent) fell in this category. Many of these fires were ignited by vehicular involvement. Some began when non-standard types of equipment ignited. However, a substantial number of Illinois fires began with *no* equipment ignition. Analysts speculate that "equipment-less" fires are frequently ignited by the involvement of matches, lighters, and other smoking paraphernalia.

In Illinois, not unlike other states, the most common *forms of material ignited* were so-called "general form" materials—trees, grass, rubbish, trash, and other similar matter. In 1983, 35.0 percent of the reported fires in Illinois were attributable to the ignition of these kinds of materials. Power transformation equipment and fuel were also common

elements of ignition (19.3 percent). Less frequent in incidence, but having a higher occurrence rate of fire deaths, were fires where furniture, soft goods, and apparel first ignited. In these incidents, 31.1 percent of Illinois fire deaths took place. Similarly, where structural compositions and finishes ignited, 14.6 percent of the reported deaths occurred. In 11.5 percent of the fires reported, responses pertaining to material ignition were left blank or unclassified. As a result, information about the forms of material ignited is not known in 40.0 percent of fire deaths reported to NFIRS in Illinois.

Findings about *ignition factors* in Illinois fires are also skewed by a large proportion (28.7 percent) of unknown or unclassified responses. Roughly 48.7 percent of the fire deaths reported in Illinois were not classified in terms of ignition factors. Where the ignition factor was known in Illinois fires, the leading category was mechanical failure which was involved in 23.1 percent of the reported fires. Another principal factor was misuse of heat of ignition (15.3 percent) which figured in NFIRS-reported fire deaths (21.4 percent).

CASUALTY SUMMARY

In general, Illinois casualties declined slightly during the past few years. For fire fighters, the risk of casualty per 1,000 fires decreased from 19.9 in 1982 to 17.6 in 1983. A more substantial decline was seen in deadly structure fires where the risk of casualty diminished from 54.3 per 1,000 structure fires in 1982 to 49.6 in 1982.

Among the civilian population, the patterns were less favorable. In terms of general risk from fire, the amount of casualties dropped slightly from 27.9 in 1982 to 27.3 per 1,000 fires in 1983. In structure fires, the risk of casualty actually increased from 75.9 per 1,000 structure fires in 1982 to 76.8 in 1983.

IOWA

In 1983, 527 of the 911 (57.8 percent) registered fire departments in Iowa submitted data to the National Fire Incident Reporting System (NFIRS). These participating fire departments reported 12,442 incidents to NFIRS in 1983. Fires in Iowa resulted in 48 reported deaths among civilians; no deaths among fire fighters were recorded in 1983.

As in other states, Iowa fire situations most commonly took place in structures (42.3 percent of all fires). In turn, it was in structure fires where the largest proportion of deaths occurred. However, the incidence of structure fire deaths was substantially lower in Iowa (72.9 percent) than the averages of the region (85.4 percent) and the nation (77.6 percent). Deaths from vehicle fires were considerably higher (25.0 percent) than averages for the region (12.2 percent) and the nation (19.0 percent). A complete listing of fire situations in Iowa and other states in the region is provided in Table 8.7.

In 1983, Iowa's fire problem was concentrated in residential and special property. During this period, 41.1 percent of all fires reported occurred in the category of special property. From these fires, which principally occurred on roadways, 27.1 percent of the reported fire deaths resulted. Residential fires, which represented 27.9 percent of all incidents, were the cause of 60.4 percent of the state's reported fire deaths. Residential fires in single family dwellings posed a particularly critical threat in Iowa. In 1983, 82.0 percent of the state's NFIRS-reported residential fires fell in this category. A list of fire incidence by categories of fixed property use is presented in Table 8.8.

ELEMENTS OF FIRE INCIDENCE

A better understanding of Iowa fire activity can be had by using NFIRS data to examine three major causal elements of fire incidence: the equipment involved in a fire's ignition; the form of material first ignited; and the ignition factor. Table Iowa-1 summarizes these data findings and is followed by a brief descriptive overview.

TABLE IOWA-1

CAUSAL FACTORS IN IOWA FIRES

Equipment Involved in Ignition {1}	**Fires**	**Deaths**
—Heating Systems	10.8%	4.2%
—Cooking Equipment	4.5%	2.1%
—Electrical Distribution Equip't.	7.1%	10.4%
—Other/No Equipment	52.0%	47.9%
Form of Material Ignited {2}	**Fires**	**Deaths**
—Structural Framework	13.7%	16.7%
—Power Transformation	22.4%	14.6%
—General Form (Grass, Trash)	37.5%	10.4%
—Furniture/Soft Goods/Apparel	8.5%	33.3%
Ignition Factor {3}	**Fires**	**Deaths**
—Misuse of Heat	37.5%	6.3%
—Mechanical Failure	27.9%	16.7%
—Operational Deficiency	9.6%	14.6%
—Arson (Incendiary & Suspicious)	9.0%	6.3%

{Note 1} In 15.7% of the incidents and 27.1% of the deaths, "Equipment Involved in Ignition" was either unknown or unclassified by Iowa NFIRS respondents.

{Note 2} In 7.7% of the incidents and 14.6% of the deaths, "Form of Material Ignited" was either unknown or unclassified by Iowa NFIRS respondents.

{Note 3} In 17.1% of the incidents and 14.6% of the deaths, "Ignition Factor" was either unknown or unclassified by Iowa NFIRS respondents.

Several types of *equipment* were commonly *involved in ignition* in Iowa fires.[36] Heating systems (10.8 percent of state NFIRS incidents), electrical distribution equipment (7.1 percent of state NFIRS incidents), and cooking equipment were prominently involved in Iowa fires. In many instances, however, fires were not ignited by these standard types of equipment. In 1983, 52.0 percent of all incidents and 47.9 percent of all fire deaths were started by other factors besides equipment. Many of these fires began as a result of vehicle involvement. In turn, many fires were started with no equipment involvement. Fire analysts speculate that many of these "equipment-less" fires are the result of ignition by matches, lighters, and other similar tools.

[36]Findings pertaining to equipment involved in ignition are impaired by a large proportion (15.7 percent) of unknown or unclassified responses. These blank responses affected findings about equipment involvement in 47.9 percent of Iowa's NFIRS-reported fire deaths.

The leading *forms of material ignited* in Iowa incidents were trees, grass, rubbish, trash, and other so-called "general form" materials. In 1983, these materials were involved in 37.5 percent of the state's NFIRS-reported fires and 10.4 percent of the deaths. Power transformation equipment and fuel, which played a slightly smaller role in fire incidence (22.4 percent), resulted in a larger proportion of fire deaths (14.6 percent). Fires where furniture, soft goods, or apparel first ignited were the most deadly; 33.3 percent of all NFIRS fire deaths in Iowa occurred in such incidents.

The principal *ignition factor* implicated in Iowa fire deaths was the misuse of heat of ignition.[37] Fires in this category resulted in 37.5 percent of the state's NFIRS-reported deaths. in this category, misuse involving abandoned materials (7.6 percent) and open fires (6.4 percent) were particularly prominent causal elements in fire deaths. Arson-related fires occurred substantially less frequency in Iowa (9.0 percent) when compared with regional (13.9 percent) and national (17.3 percent) averages.

CASUALTY SUMMARY

The risk of fire casualties among both civilian and fire fighter populations declined in Iowa. In 1982, there were 19.5 casualties—including both deaths and injuries—per 1,000 fires among fire fighters. In 1983, the number of casualties decreased to 14.9. In terms of structure fires, which typically represent the core of risk for fire fighters, the figure declined from 42.0 per 1,000 structure fires in 1982 to 33.2 casualties per 1,000 structure fires.

For civilians, a similar pattern is observed. In 1982, the general risk was measured as 29.7 casualties per 1,000 fires compared to 21.7 in 1983. In terms of structure fires, the number of casualties diminished from 63.8 to 51.3 per 1,000 fires.

KANSAS

Of the states in Region III, Kansas had one the lowest rates of participation—24.6 percent—in the National Fire Incident Reporting System (NFIRS). During 1983, only 229 of the 930 registered fire departments in Kansas submitted data to NFIRS. Because of the small amount of participation, findings contained in this section may not be fully representational of the 1983 fire problem in Kansas.

During the year, participating Kansas departments reported 14,660 fires to NFIRS. These fires resulted in 512 injuries (226 among fire fighters) and 40 civilian deaths. No fire-related fatality involving the state's fire service was reported to NFIRS during 1983.

Structure fires, which represented 31.6 percent of the state's NFIRS incidents; vehicle fires, which represented 24.3 percent; and trees, grass, and brush fires, which constituted 25.9 percent, had the highest proportion of incidence in Kansas fire situations. Together, these categories accounted for 81.7 percent of all NFIRS-reported fires in the state during 1983. There was also a significant proportion of refuse and trash fires (14.2 percent). Fire deaths most often resulted from two categories: structure fires (52.5 percent of all NFIRS-reported deaths) and vehicle fires (35.0 percent). The proportion of deaths from vehicle fires was considerably higher than the regional (12.2 percent) and national (19.0 percent) averages. A complete listing of fire situations in Kansas and other states in Region III is provided in Table 8.7.

[37]In 17.1 percent of NFIRS reports, responses pertaining to factors of ignition were unclassified or unknown. This affected the causal findings concerning 14.6 percent of the fire deaths. As a result, the findings contained in this section may not be fully representational.

An examination of fire incidence by category of fixed property use indicates that special property fires had a lower rate of incidence in Kansas (42.5 percent) when compared to regional (50.4 percent) and national (46.9 percent) averages. Despite this low incidence, deaths from special property fires in Kansas (30.0 percent) occurred at a startlingly high rate of frequency (30.0 percent) when compared to regional (10.9 percent) and national (19.1 percent) averages. In turn, Kansas fires involving residential properties resulted in a smaller incidence of deaths (55.0 percent) than regional (79.6 percent) and national (72.6 percent) averages. A comprehensive list of fire incidence by fixed property use is provided in Table 8.8.[38]

ELEMENTS OF FIRE INCIDENCE

Additional insights about fires in Kansas can be had by using NFIRS data to examine three major causal factors of fire incidence: the equipment involved in a fire's ignition; the form of material first ignited; and the ignition factor. Table Kansas-1 summarizes key findings pertaining to these data and is followed by a brief descriptive overview.

TABLE KANSAS-1

CAUSAL FACTORS OF KANSAS FIRES

Equipment Involved in Ignition {1}	**Fires**	**Deaths**
—Heating Systems	5.7%	10.0%
—Electrical Distribution	4.4%	5.0%
—Cooking Equipment	3.6%	15.0%
—Other/No Equipment	46.2%	27.5%
Form of Material Ignited {2}	**Fires**	**Deaths**
—Structural Material	10.3%	5.0%
—Power Transformation	18.2%	20.0%
—General Form (Grass/Trash)	42.1%	10.0%
—Furniture/Soft Goods/Apparel	7.8%	17.5%
Ignition Factor {3}	**Fires**	**Deaths**
—Misuse of Heat	23.1%	30.0%
—Mechanical Failure	25.1%	10.0%
—Misuse of Material Ignited	6.8%	5.0%
—Arson (Incendiary, Suspicious)	9.6%	7.5%

{Note 1} In 32.6% of the incidents and 35.0% of deaths, "Equipment Involved in Ignition" was either unknown or unclassified by Kansas NFIRS respondents.

{Note 2} In 7.2% of the incidents and 15.0% of the deaths, "Form of Material Ignited" was either unknown or unclassified.

{Note 3} In 18.6% of the incidents and 20.0% of the deaths, "Ignition Factor" was either unknown or unclassified.

[38]In 2.7 percent of the incidents, the category of fixed property use was either not known or not classified by Kansas NFIRS respondents. Because of this, findings contained in this section may be slightly skewed.

As the preceding table indicates, in fires where standard types of *equipment were involved*, heating systems (5.6 percent of NFIRS-reported incidents), electrical distribution (4.4 percent) and cooking equipment (3.6 percent) figured prominently. However, many fires in Kansas, as in other states, did not start as a result of standard equipment ignition. In 1983, 46.2 percent of the state's incidents were ignited by other factors. Many of these fires began by vehicular involvement. And, many were ignited without any equipment involvement. Fire analysts speculate that these "equipment-less" fires were often started by matches, lighters, and other similar materials.[39]

Forms of material ignited most commonly were trees, grass, trash, and other so-called "general form" materials.[40] In Kansas, fires involving these materials represented 42.1 percent of the state's NFIRS incidents. These fires occurred at a higher rate of frequency than at the national level (37.7 percent). Deaths from these fires also took place more often in Kansas (10.0 percent) than in the region (8.2 percent) or the nation as a whole (4.6 percent). Other material forms having a high proportion of incidence included structural framework (10.3 percent) and power transformation equipment and fuel (18.1 percent). The latter category resulted in particularly deadly incidents (20.0 percent of the NFIRS-reported fatalities). Fires involving furniture, soft goods, and apparel had a comparatively low rate of incidence (7.8 percent) but resulted in a rather large proportion of deaths (17.5 percent).

Prevalent *ignition factors* in Kansas fires during 1983 were mechanical failure (25.1 percent), misuse of heat source (23.1 percent), and misuse of material ignited (6.8 percent).[41] The largest incidence of deaths resulted from fires involving the misuse of heat of ignition (30.0 percent). Arson-related fires were far less frequent in Kansas (9.6 percent) when compared to regional (13.9 percent) and national (17.3 percent) averages.

CASUALTY SUMMARY

Civilian casualties, both deaths and injuries, increased slightly, rising from 20.8 per 1,000 fires in 1982 to to 22.2 in 1983. In terms of risk from structure fires, civilian casualties per 1,000 structure fires increased from 66.2 in 1982 to 70.4 in 1983. Fire fighter casualties, on the other hand, decreased from 18.3 per 1,000 fires in 1982 to 15.4 in 1983. Looking solely at structure fires, the number dropped from 58.1 fire fighter casualties per 1,000 structure fires in 1982 to 48.8 in 1983.

MICHIGAN

A little over 80 percent (82.2) of the 1,025 registered fire departments in Michigan submitted NFIRS data during 1983. This high rate of participation helps to strengthen the NFIRS data base and improves our understanding of this state's fire activity. We look

[39]In reviewing these data, it is important to note that equipment involvement was either unknown or unclassified by Kansas NFIRS respondents in 32.6 percent of the total incidents and 35.0 percent of the deaths. Because of this, data findings contained in this section may not be fully representational.

[40]In 7.2 percent of the incidents and 15.0 percent of the deaths, the form of material ignited was either not known or not classified by Kansas NFIRS participants. Because of this, findings may not be fully representational.

[41]In 18.6 percent of the incidents and 20.0 percent of the deaths, the ignition factor was either not known or not classified by Kansas NFIRS respondents. Because of this, findings contained in this section may not be fully representational.

forward to even higher levels of participation and improved attention to classification by Michigan NFIRS respondents in future years.

During 1983, Michigan fire departments reported a total of 70,140 incidents to NFIRS. These fires resulted in 2,235 reported injuries (including 1,173 sustained by fire fighters) and 192 deaths (including four fire fighter fatalities).

The major part of the state's 1983 fire problem was centered around structure fires (39.2 percent of the state's NFIRS incidents); vehicle fires (23.1 percent); refuse fires (18.5 percent); and trees, brush, and grasslands fires (15.8 percent) which collectively accounted for 96.4 percent of the state's reported incidents. Structure fires posed a particularly severe element of Michigan's 1983 fire experience. During this period, 88.5 percent of the deaths reported to NFIRS were attributed to structure fires—a higher rate of incidence than both regional (85.4 percent) and national (77.6 percent) averages. A comparative listing of fire situations found in Michigan and other Region III states is provided in Table 8.7.

An analysis of fire incidence by fixed property use provides valuable insights about Michigan's fire experience. In 1983, 87.0 percent of all NFIRS-reported incidents fell in one of two categories: special property (58.2 percent) and residential property (28.8 percent). Moreover, residential property fires were the source of 83.9 percent of Michigan's fire deaths. This death rate is above the Region III average of 79.6 percent and is considerably higher than the national average of 72.6 percent. Michigan's death rate from special property fires was 10.4 percent—a figure in line the regional average of 10.9 percent. Special property fires included roadways (35.2 percent) and grasslands (12.5 percent). The only remaining category of fixed property use having a substantial proportion of fire incidence was commercial property in which 10.0 percent of the reported fires took place. Commercial property fires were implicated in only 1.0 percent of Michigan's fire deaths. A complete list of fire incidence by categories of fixed property use in Michigan and other Region III states is provided in Table 8.8.

ELEMENTS OF FIRE INCIDENCE

Further understanding of fire activity in Michigan can be achieved by using NFIRS data to analyze three major causal elements of fire incidence: the equipment involved in fire ignition; the form of material first ignited; and the ignition factor. Key data findings pertaining to these causal elements are presented in Table Michigan-1 and are followed by a brief descriptive overview.

TABLE MICHIGAN-1

CAUSAL FACTORS IN MICHIGAN FIRES

Equipment Involved in Ignition {1}	Fires	Deaths
—Heating Systems	7.0%	6.8%
—Electrical Distribution	3.5%	1.0%
—Cooking Equipment	3.1%	3.1%
—Other/No Equipment	19.1%	17.7%

Form of Material Ignited {2}	Fires	Deaths
—Structural Framework	8.4%	4.7%
—Power Transformation/Fuel	17.7%	14.6%
—General Form (Grass, Trash)	39.2%	9.4%
—Furniture/Soft Goods/Apparel	8.9%	32.8%

Ignition Factor {3}	Fires	Deaths
—Misuse of Heat	27.0%	31.8%
—Mechanical Failure	19.3%	4.7%
—Misuse of Material Ignited	6.6%	10.4%
—Operational Deficiency	6.6%	9.9%
—Arson (Incendiary, Suspicious)	17.8%	18.2%

{Note 1} In a very large proportion of the incidents (61.1%) and the deaths (69.3%), "Equipment Involved in Ignition" was either unknown or unclassified by Michigan NFIRS respondents.

{Note 2} In 14.3% of the incidents and 31.8% of the deaths, "Form of Material Ignited" was either unknown or unclassified by Michigan NFIRS respondents.

{Note 3} In 14.8% of the incidents and 25.0% of the deaths, "Ignition Factor" was either unknown or unclassified by Michigan NFIRS respondents.

As the preceding table indicates, in fires where standard types of *equipment were involved in ignition*, heating systems had a prominent role.[42] Fires where heating systems ignited represented 7.0 percent of Michigan's incidents and 6.8 percent of the state's NFIRS-recorded deaths. Remaining categories of standard equipment; e.g., cooking equipment and electrical distribution equipment had a smaller proportion of involvement. A substantial proportion of fires in Michigan were started by factors other than the ignition of standard equipment. In 1983, 19.1 percent of Michigan's fires began by other factors. In some instances, these fires were started by vehicular involvement; others were ignited without any equipment involvement. Fire analysts speculate that some of these incidents may have been started by matches, lighters, and other similar materials.

[42]In over 60 percent of the incidents (61.1) and nearly 70 percent of the deaths (69.3), equipment involvement in ignition was either unknown or unclassified by Michigan NFIRS respondents. Because of this, the findings contained in this section may not be fully representational.

As in other states, the principal *forms of materials ignited* in Michigan fires were trees, grass, trash, and other matter. Known as "general form" materials, these substances were involved in 39.2 percent of the fires in Michigan and 9.4 percent of the deaths.[43] Second-ranking in terms of incidence were fires where power transformation equipment or fuel ignited. These fires represented 17.7 percent of all NFIRS incidents and 14.6 percent of the deaths. Occurring less frequency (8.9 percent), but posing a far greater threat to human life (32.8 percent of state NFIRS-reported deaths), were fires where furniture, soft goods, and apparel ignited.

The leading ignition factor in Michigan fires was misuse of heat of ignition, which was involved in 27.0 percent of the NFIRS incidents and 31.8 percent of the deaths.[44] Michigan had a higher rate of incidence involving this ignition factor than the region (18.0 percent) and the nation (16.6 percent) as a whole. Death rates from fires started by misuse of heat in Michigan were higher than the national average (25.8 percent) but were in keeping regional proportions (31.8 percent). Arson-related fires, which represented 17.8 percent of Michigan's NFIRS incidents, occurred in excess of the regional average (13.9 percent) but were in line the national rate (17.3 percent). Unfortunately, the proportion of deaths resulting from incendiary and suspicious fires was considerably higher in Michigan (18.2 percent) than in the region (13.9 percent) and the nation (13.9 percent).

CASUALTY SUMMARY

The risk of casualty from fires generally remained stable in Michigan during the past few years. Among the state's civilian population, the number of casualties in 1982 was 17.7 per 1,000 fires compared to 17.8 in 1983. In terms of structure fires, the number of casualties among civilians increased from 45.1 per 1,000 fires in 1982 to 45.5 in 1983.

For fire fighters, the general level of casualty declined from 17.8 per 1,000 fires in 1982 to 16.8 in 1983. Looking only at structure fires, the number of casualties decreased from 45.3 per 1,000 structure fires in 1982 to 42.9 in 1983.

MINNESOTA

Over 60 percent (64.8) of the 790 registered fire departments in Minnesota submitted data to the National Fire Incident Reporting System (NFIRS) in 1983. During this period, participating departments reported 15,163 fire incidents. From these incidents, 73 deaths among civilians, 1 fire fighter death, 229 civilian injuries, and 158 fire fighter injuries were reported.

Minnesota incidents which were most commonly found were structure fires (50.6 percent of the state's NFIRS total), vehicle fires (25.4 percent), and trees, brush, and grasslands fires (13.8 percent). Minnesota departments reported one of the highest rates of structure fire incidence in Region III. The state's proportion of structure fires was well above the regional (40.4 percent) and national (35.8 percent). In turn, deaths from structure fires also represented a higher rate in Minnesota (93.2 percent) than in the

[43]In 14.3 percent of the fires and 31.8 percent of the deaths, the form of material ignited was either not known or not classified by Michigan NFIRS respondents. As a result, the findings contained in this section may not be fully representational.

[44]In 14.8 percent of the incidents and 25.0 percent of the deaths, the ignition factor was either not known or not classified by Michigan NFIRS respondents. Because of this, findings may not be fully representational.

region (85.4 percent) and the nation (77.6 percent). A complete listing of fire situations found in Minnesota during 1983 and in other Region III states is provided in Table 8.7.

A look at Minnesota fire incidence by categories of fixed property use gleans additional insights. As in most other states, fires in Minnesota most frequently occurred in outdoor areas, roadways, and other "special property" categories. In 1983, 41.8 percent of all reported fires in Minnesota took place in this category. Of the Region III states, Minnesota had the second highest proportion of residential fire incidence. A little over 38 percent (38.1) of the Minnesota fires reported took place in residential properties. Unfortunately, Minnesota departments also reported the highest proportion of residential deaths (87.8 percent) in the region. A complete list of fire incidence by fixed property use categories in Minnesota and other Region III states is provided in Table 8.8.

ELEMENTS OF FIRE INCIDENCE

A more detailed examination of Minnesota fire incidence can be undertaken by using NFIRS data to review three major causal elements of fire activity: the equipment involved in ignition; the form of material first ignited; and the ignition factor. Table Minnesota-1 summarizes some of the key findings pertaining to these data and is followed by a brief descriptive overview.

TABLE MINNESOTA-1

CAUSAL FACTORS IN MINNESOTA FIRES

Equipment Involved in Ignition {1}	**Fires**	**Deaths**
—Heating System	16.7%	20.3%
—Electrical Distribution Equipment	6.4%	10.8%
—Cooking Equipment	5.5%	2.7%
—Other/No Equipment	36.9%	39.2%
Form of Material Ignited {2}	**Fires**	**Deaths**
—Structural Framework	12.1%	16.2%
—Power Transformation	17.3%	5.4%
—General Form (Grass, Trash)	32.0%	4.1%
—Furniture/Soft Goods/Apparel	6.8%	35.1%
Ignition Factor {3}	**Fires**	**Deaths**
—Misuse of Heat	11.8%	37.8%
—Mechanical Failure	22.1%	16.2%
—Operational Deficiency	12.0%	10.8%
—Arson (Incendiary, Suspicious)	11.0%	5.4%

{Note 1} In 25.6% of the incidents and 18.9% of the deaths, "Equipment Involved in Ignition" was either unknown or unclassified.

{Note 2} In 22.3% of the incidents and 21.6% of the deaths, "Form of Material Ignited" was either unknown or unclassified.

{Note 3} In 29.0% of the incidents and 16.2% of the deaths, "Ignition Factor" was either unknown or unclassified.

Before looking at *equipment involvement in ignition*, some background regarding the structure of NFIRS will be helpful. In NFIRS, standard types of equipment fall under one of eight general categories: air conditioning; appliances; special equipment; processing equipment; service equipment; heating systems; cooking equipment; and electrical distribution equipment. Generally speaking, it is the latter three classifications which have the largest involvement in fire ignition. Because of this, only the fire records of these three equipment categories are included in the preceding table.

In Minnesota fires where standard equipment was involved, heating systems were most often at hand in ignition (16.7 percent of state NFIRS incidents).[45] Electrical distribution equipment (6.4 percent) and cooking equipment (5.5 percent) also were causal factors in some incidents.

Often factors other than standard equipment were involved in the ignition of Minnesota fires. Vehicular involvement, for example, was responsible for the ignition of a number of Minnesota fires. Many Minnesota fires started without any equipment involvement. These fires may have been ignited by matches, lighters, and other similar paraphernalia. Over 35 percent (36.9) of the incidents and 39.2 percent of the deaths in Minnesota were the result of other factors besides the ignition of standard categories of equipment.

The *form of material* most commonly ignited in Minnesota fires was "general form" material; e.g., trees, grass, trash, and other similar matter.[46] While this form of material was frequently involved in Minnesota fires (32.0 percent of the state NFIRS incidents), only 4.1 percent of the state's deaths occurred from fires involving these materials. In turn, while furniture, soft goods, and apparel were the first forms ignited in only 6.8 percent of the reported incidents, roughly one-fifth of the state's NFIRS-recorded deaths (20.3 percent) resulted from fires involving these materials.

With regard to *ignition factors*, incidents started by misuse of heat resulted in a substantial percentage of fire deaths (37.8 percent) although such factors accounted for only 11.8 percent of the reported incidents.[47] In terms of general fire incidence, the leading factor of ignition in Minnesota was mechanical failure which was implicated in 22.1 percent of the fires reported in Minnesota.

CASUALTY SUMMARY

Reported casualties—including both deaths and injuries—decreased moderately for Minnesota fire fighters in recent years, from 16.2 per 1,000 fires in 1982 to 10.5 in 1983. In terms of structure fires, the incidence of casualty among fire fighters declined from 32.7 per 1,000 structure fires in 1982 to 20.7 in 1983. Civilian casualties declined from 23.3 to 19.9.

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[45]In 25.6 percent of the incidents and 18.9 percent of the deaths, equipment involvement was either unknown or unclassified by Minnesota NFIRS respondents. Because of this, findings contained in this section may not be fully representational.

[46]In 22.3 percent of the incidents and 21.6 percent of the deaths, the form of material ignited was either unknown or unclassified by Minnesota NFIRS respondents. As a result, these findings may not be fully representational.

[47]In 29.0 percent of the incidents and 16.2 percent of the deaths, the ignition factor was either unknown or unclassified. As a result, the findings contained in this section may not be fully representational.

This pattern is further evident when civilian casualties are examined. The general incidence decreased from 23.3 per 1,000 fires in 1982 to 19.9 in 1983. Looking only at structure fires, the number dropped from 46.9 casualties per 1,000 structure fires in 1982 to 39.3 in 1983.

OHIO

In 1983, Ohio had one of the more impressive records of participation in the National Fire Incident Reporting System (NFIRS) in 1983. Of the states in Region III, Ohio had the largest number of participating fire departments (1,002) and one of the highest rates of participation (78.9 percent). By and large, Ohio fire departments also were generally rigorous in the quality of their NFIRS reporting by maintaining a relatively low level of unclassified responses. We thank these Ohio departments for their support.

During the year, there were 64,433 fire incidents reported by participating fire departments in Ohio. From these fires, 221 civilian deaths and one fire fighter fatality resulted. A total incidence of 3,324 injuries (1,640 suffered among fire fighters) were reported during this period.

Structure and vehicle fires formed the core of the 1983 fire problem—collectively representing 68.7 percent of all incidences. In turn, these two categories accounted for over 99 percent of the state's NFIRS-reported fire deaths. A complete listing of 1983 fire situations in Ohio and other Region III states is provided in Table 8.7.

A look at Ohio fire activity by categories of fixed property use offers additional insights regarding the nature of the state's fire problem. As in other states, most Ohio fires took place on "special property," e.g., outdoor areas, roadways, construction sites, and other such locales. Nearly 60 percent (58.4) of Ohio's fires fell in this category. The proportion of special property fires was higher than the regional (50.4 percent) and the national (46.9 percent) averages. Fortunately, special property fires are inclined to have low incidences of death. In fact, Ohio reported the lowest rate of special property fire deaths in Region III (5.9 percent compared to the regional average of 10.9 percent). On the other hand, there were more deaths on Ohio residential properties than for the Region III average (85.1 percent vs. 79.6 percent). A complete list of fire incidence by fixed property use in Ohio and other Region III states is provided in Table 8.8.

ELEMENTS OF FIRE INCIDENCE

Further analysis of Ohio fire activity can be undertaken by using NFIRS data to examine three major causal elements of fire incidence: the equipment involved in ignition; the form of material first ignited; and the ignition factor. Table Ohio-1 summarizes principal findings pertaining to these data and is followed by a brief descriptive overview.

TABLE OHIO-1

CAUSAL FACTORS OF OHIO FIRES

Equipment Involved in Ignition {1}	Fires	Deaths
—Heating Systems	9.2%	13.5%
—Cooking Equipment	5.9%	8.1%
—Electrical Distribution	3.7%	4.9%
—Other/No Equipment	75.2%	66.2%

Form of Material Ignited {2}	Fires	Deaths
—Structural Framework	9.2%	13.5%
—Power Transformation	22.3%	14.4%
—General Form (Grass/Trash)	37.5%	5.9%
—Furniture/Soft Goods/Apparel	8.7%	34.2%

Ignition Factor {3}	Fires	Deaths
—Misuse of Heat	10.5%	37.8%
—Mechanical Failure	24.6%	7.7%
—Operational Deficiency	9.7%	9.0%
—Arson (Incendiary/Suspicious)	12.8%	7.2%

{Note 1} In 1.2% of the incidents and 3.6% of the deaths, "Equipment Involved in Ignition" was either unknown or unclassified.

{Note 2} In 10.0% of the incidents and 20.7% of the deaths, "Form of Material Ignited" was either unknown or unclassified.

{Note 3} In 32.1% of the incidents and 27.0% of the deaths, "Ignition Factor" was either unknown or unclassified.

As the preceding table indicates, in fires where standard types of *equipment were involved in ignition*, heating systems and cooking appliances were found to have a fairly substantial role in Ohio fire cause.[48] Fires started by these two categories of equipment collectively represented 15.1 percent of the state NFIRS incidents. Many fires in Ohio began by other factors besides the ignition of standard types of equipment. In 1983, over three-fourths (75.2 percent) of the state's fires fell under this category. Of these fires, many started from vehicular involvement and many began without any equipment. In the latter instance, analysts speculate, fires often were ignited from matches, lighters, and other related materials.

The *forms of material ignited* in Ohio fires most often were so-called "general form" materials; e.g., grass, trees, trash, and other matter.[49] Fires involving these materials made up 37.5 percent of all incidents but only 5.9 percent of Ohio's fire deaths resulted from these incidents. In turn, while only 8.7 percent of the fires involved furniture, soft goods, and apparel, 34.2 percent of all fire deaths were attributed to incidents where these materials ignited.

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[48]In 1.2 percent of the fires and 3.6 percent of the deaths, equipment involvement was either unknown or unclassified. Because of this, these findings may not be entirely representational.

[49]In 10.0 percent of the incidents and 20.7 percent of the deaths, the form of material was either unknown or unclassified by Ohio NFIRS respondents. Because of this, these findings may not be fully representational.

The leading *ignition factor* in Ohio fires was mechanical failure which was at hand in 24.6 percent of the state's NFIRS incidents and was implicated in 7.7 percent of the fire deaths. Misuse of heat of ignition, another control element, was an *ignition factor* in only 10.5 percent of the NFIRS-reported fires in Ohio but accounted for 37.8 percent of the fire deaths.[50]

CASUALTY SUMMARY

The risk of casualty from fires in Ohio declined slightly from 29.6 per 1,000 fires in 1982 to 27.3 casualties in 1983. In terms of structure fires, the rate of incidence decreased from 71.0 civilian casualties per 1,000 structure fires in 1982 to 66.0 in 1983.

Among fire fighters, the general level of risk rose from 25.5 casualties in 1982 to 28.8 per 1,000 fires in 1983. Looking solely at structure fires, the level of casualties increased from 61.1 per 1,000 structure fires in 1982 to 69.5 in 1983.

SOUTH DAKOTA

In 1983, only a little over one-half (56.9 percent) of the 341 registered fire departments in South Dakota participated in the National Fire Incident Reporting System (NFIRS). These 194 fire departments—based in the state having the smallest population in Region III—reported a total of 3,126 incidents. From these fires, 69 injuries (21 among fire fighters) and 19 deaths among civilians occurred. No deaths among fire fighters were recorded during this period.

Based on NFIRS situational data, fires involving structures, vehicles, trees, brush, and grass posed the largest problem for the state. Collectively, these categories represented 83.9 percent of the NFIRS fires reported in South Dakota. Seventeen of the state's 19 fire deaths were the result of fires in structures (63.2 percent of the NFIRS fatalities) and vehicles (26.3 percent). However, South Dakota's rate of structure fire deaths was considerably lower than the regional average (85.4 percent). In turn, vehicle fire deaths were higher than in the region overall (12.2 percent). A complete listing of fire situations found in South Dakota and other Region III states is provided in Table 8.7.

Analysis of data pertaining to fire incidence by fixed property use categories suggests that most fires in South Dakota occurred in residential properties (27.3 percent of state NFIRS incidents).[51] From these fires, 85.1 percent of the NFIRS-recorded deaths resulted. The proportion of residential fire deaths in South Dakota was higher than regional (79.6 percent) and national (72.6 percent) averages. A complete listing of fire incidence by fixed property use in South Dakota and other Region III states is presented in Table 8.8.

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[50]In 32.1 percent of the incidents and 27.0 percent of the deaths, the ignition factor was either unknown or unclassified by Ohio NFIRS respondents. Because of this, findings contained in this section may not be fully representational.

[51]In 26.3 percent of the incidents and 15.8 percent of the deaths, fixed property use categories were either unknown or unclassified by South Dakota NFIRS respondents. Because of this, the findings contained in this section may not be fully representational.

ELEMENTS OF FIRE INCIDENCE

Further analysis of South Dakota fire activity can be undertaken by using NFIRS data to examine three major categories of fire incidence: the equipment involved in fire ignition; the form of material first ignited; and the ignition factor. Table South Dakota-1 summarizes principal data findings pertaining to this topic and is followed by a brief descriptive overview.

TABLE SOUTH DAKOTA-1

CAUSAL FACTORS IN SOUTH DAKOTA FIRES

Equipment Involved in Ignition {1}	**Fires**	**Deaths**
—Heating Systems	11.6%	10.5%
—Cooking Equipment	3.3%	0.0
—Electrical Distribution	.5%	36.8%
—Other/No Equipment	60.1%	42.1%
Form of Material Ignited {2}	**Fires**	**Deaths**
—Structural Framework	12.3%	0.0
—Power Transformation	16.6%	47.4%
—General Form (Grass, Trash)	42.4%	10.5%
—Furniture/Soft Goods/Apparel	6.7%	31.6%
Ignition Factor {3}	**Fires**	**Deaths**
—Misuse of Heat	18.1%	5.3%
—Mechanical Failure	27.0%	7.7%
—Operational Deficiency	9.0%	21.1%
—Arson (Incendiary, Suspicious)	6.3%	5.3%

{Note 1} In 7.4% of the incidents and 5.3% of the deaths, "Equipment Involved in Ignition" was either unknown or unclassified.

{Note 2} In 7.4% of the incidents, "Form of Material Ignited" was either unknown or unclassified.

{Note 3} In 13.4% of the incidents and 26.3% of the deaths, "Ignition Factor" was either unknown or unclassified.

As the preceding table indicates, in fires where standard categories of *equipment were involved in ignition,* heating systems figured prominently (11.6 percent of state NFIRS incidents).[52] While less common, fires involving the ignition of electrical distribution equipment (7.5 percent) also were at hand. In many of the state's fires, other factors besides standard equipment categories caused fire ignition (60.1 percent of the incidents and 42.1 percent of the deaths). Some of these fires were the result of vehicle involvement. Others were ignited without any equipment involvement. In the latter case, analysts speculate, many fires were ignited by matches, lighters, and other "non-equipment" materials.

[52]In 7.4 percent of the incidents and 5.3 percent of the deaths, equipment involvement in igniton was either unknown or unclassified by South Dakota NFIRS respondents. As a result, findings may not be fully representational.

South Dakota fires most often involved the ignition of general form materials; e.g., trees, grass, brush, and other similar substances. In 1983, these materials were ignited in 42.4 percent of the deaths. Less common but far more deadly were fires involving power transformation equipment and fuel. These fires represented 16.6 percent of the NFIRS incidents and 47.4 percent of the recorded deaths. South Dakota had the largest proportion of power transformation fire deaths in Region III. The state's rate was considerably higher than that of the region (13.3 percent) and the nation (12.8 percent).

The leading *ignition factor* in South Dakota fires was mechanical failure, which represented 27.0 percent of the state NFIRS incidents and was implicated in 14.9 percent of the deaths. Arson-related fires, which accounted for 6.3 percent of the fires and 5.3 percent of the deaths in South Dakota, occurred far less frequently than in the region (13.9 percent of all incidents and 9.4 percent of all deaths) and the nation (17.3 percent and 13.9 percent respectively).

CASUALTY SUMMARY

The risk of casualty—including both injuries and deaths—declined substantially for fire fighters in South Dakota. In 1983, only 6.7 casualties per 1,000 fires were measured compared to 11.6 in 1983. Looking solely at structure fires, the trend was even stronger: in 1983, 19.9 casualties per 1,000 structure fires were measured compared to 26.2 in 1982.

For civilians, the likelihood of casualty from structure fires increased from 47.2 casualties per 1,000 structure fires in 1982 to 60.6 in 1983. The risk of casualty from fires in general increased slightly—from 20.8 per 1,000 fires in 1982 to 21.4 in 1983.

WISCONSIN

In 1983, Wisconsin had one of the lowest rates of participation in the National Fire Incident Reporting System (NFIRS) of the states in Region III. Slightly less than half (45.6 percent) of the state's 901 registered fire departments submitted data to NFIRS. The support of Wisconsin's NFIRS participants is exceptional. The thoroughness of Wisconsin department reporting has contributed to the NFIRS data base, helping to strengthen and improve its overall quality.

During 1983, Wisconsin's 411 participating fire departments reported a total of 14,066 fire incidents to NFIRS. Within this period, no deaths among fire fighters and 47 deaths among civilians were recorded. The total number of injuries reported was 619 (313 civilians and 306 fire fighters). As in other states, structure and vehicle fires constituted the largest aspect of the Wisconsin fire problem. Collectively these fires were implicated in 97.9 percent of the state's NFIRS-reported fire deaths. Wisconsin departments reported the highest rate of structure fires (52.4 percent compared to 40.4 percent for the region as a whole) in the region. A complete list of 1983 fire situations found in Wisconsin and other Region III states is provided in Table 8.7.

Looking at fire incidence in terms of fixed property use reveals that Wisconsin's residential fires accounted for the largest proportion of incidence. Wisconsin is an exception to the fire experience of most states in this respect. Routinely, it is special property fires that have the highest occurrence rate. In Region III, for example, a little over one-half (50.4 percent) the incidents reported during 1983 took place in categories of special property. Compare this to Wisconsin's experience where only 25.0 percent of the fires reported took place in special properties. In turn, residential property fires, which typically pose grave casualty threats, accounted for 43.0 percent of all NFIRS incidents

in Wisconsin. Fortunately, Wisconsin's residential fire death rate—74.5 percent—was below the average for the region and only slightly above that for the nation. A complete list of fire occurrence by categories of fixed property use in Wisconsin and other Region III states is presented in Table 8.8.

ELEMENTS OF FIRE INCIDENCE

Further analysis of Wisconsin fire activity can be undertaken by using NFIRS data to examine three major causal elements of fire incidence: the equipment involved in fire ignition; the form of material first ignited; and the ignition factor. Table Wisconsin-1 summarizes principal data findings on this topic and is followed by a brief descriptive overview.

TABLE WISCONSIN-1

CAUSAL FACTORS IN WISCONSIN FIRES

Equipment Involved in Ignition {1}	**Fires**	**Deaths**
—Heating Systems	25.0%	8.5%
—Electrical Distribution Equipment	6.9%	10.6%
—Cooking Equipment	5.3%	8.5%
—Other/ No Equipment	45.1%	44.7%
Form of Material Ignited {2}	**Fires**	**Deaths**
—Structural Framework	10.9%	12.8%
—Power Transformation	17.7%	19.1%
—General Form (Grass, Trash)	47.3%	25.5%
—Furniture/Soft Goods/Apparel	7.4%	6.4%
Ignition Factor {3}	**Fires**	**Deaths**
—Misuse of Heat of Ignition	15.2%	21.3%
—Mechanical Failure	31.6%	14.9%
—Operational Deficiency	15.3%	19.1%
—Arson (Incendiary,Suspicious)	9.1%	4.3%

{Note 1} In 8.7% of the incidents and 25.5% of the deaths, "Equipment Involved in Ignition" was either unknown or unclassified.

{Note 2} In 4.0% of the incidents and 17.0% of the deaths, "Form of Material Ignited" was either unknown or unclassified.

{Note 3} In 12.8% of the incidents and 29.8% of the deaths, the "Ignition Factor" was either unknown or unclassified.

As the preceding table indicates, in fires where standard categories of *equipment were involved in ignition*, heating systems (25.0 percent) figured most prominently.[53] Other leading standard equipment categories—although in considerably smaller propor-

[53]In 8.7 percent of the incidents and 25.5 percent of the deaths, equipment involvement was either unknown or unclassified by Wisconsin NFIRS respondents. Because of this, findings contained in this section may not be fully representational.

tions—were electrical distribution equipment (6.9 percent) and cooking equipment (5.2 percent). In keeping regional national trends, in many Wisconsin fires, factors other than standard equipment often were involved in ignition. In 1983, 45.1 percent of the fires reported and 44.7 percent of the deaths fell under this category. Fires started without standard equipment involvement are often ignited by vehicle involvement. And, in many instances, "equipment-less" fires may have been caused by the ignition of matches, lighters, and similar materials.

Analysis of data about the *form of material ignited* indicates that general form materials—trees, grass, rubbish, and other similar substances—had the highest proportion of fire incidence (47.3 percent) and death (25.5 percent) in Wisconsin fires.[54] Moreover, according to NFIRS data, Wisconsin fire rates involving general form materials greatly exceeded regional (38.2 percent of incidents and 8.2 percent of deaths) and national (37.7 percent of incidents and 4.6 percent of deaths) averages, particularly in terms of fire-related deaths. Power transformation (17.8 percent of all incidents and 19.1 percent of all deaths) and structural framework (10.9 percent at 12.8 percent respectively) also were principal categories of material ignition.

Primary *ignition factors* in Wisconsin fires were mechanical failure (31.6 percent of all incidents), operational deficiency (15.3 percent), misuse of heat of ignition (15.2 percent) and arson (9.1 percent). Wisconsin data suggest that the largest causes of fire death were misuse of heat of ignition (21.3 percent) and operational deficiency (19.1 percent). However, nearly 30 percent (29.8 percent) of the deaths that took place were unknown or uncategorized by Wisconsin NFIRS respondents pertaining to factors of ignition; hence, these findings may not be fully representational.

CASUALTY SUMMARY

The likelihood of casualty by fire among Wisconsin's civilian population increased moderately between 1982 and 1983. In 1983, civilian casualties were 27.6 per 1,000 fires compared to 25.6 percent in 1982. In turn, civilian casualties per 1,000 *structure* fires were 51.9 in 1983 compared to 48.9 in 1982.

This same trend in structure fires carried over to fire fighters the number of casualties per 1,000 structure fires increased from 41.5 in 1982 to 53.4 in 1983. In terms of fires in general, however, the risk of casualty among fire fighters decreased slightly—from 28.4 casualties per 1,000 fires in 1982 to 21.8 in 1983.

FIRE ACTIVITY IN REGION IV

The vast area of the Western United States forms Region IV of the National Fire Incident Reporting System. Twelve of the states in this region participated in NFIRS in 1983: Alaska, California, Colorado, Hawaii, Idaho, Montana, Oregon, Texas, Utah, Washington, Wyoming, and Arizona. With the exception of Arizona, all states routinely provided NFIRS case-by-case accounts regarding fire incidence during the year. The regional analysis presented in this section is a compendium of these states' data. Separate analyses for each participating state follows the regional analysis. Arizona, although an NFIRS participant, did not submit data and, consequently, no analysis of that state's fire

[54]In 4.0 percent of the fires and 17.0 percent of the deaths, the form of material ignited was either unknown or unclassified by Wisconsin NFIRS respondents. As a result, the findings contained in this section may not be fully representational.

activity has been prepared. The only remaining states in Region IV, Nevada, New Mexico, and Oklahoma did not participate in NFIRS and, so, are excluded from this analysis.

NFIRS data, as applied in the following pages, provides an excellent opportunity for fire professionals, public policy analysts, elected officials, and other interested parties to explore the 1983 fire experience of a given region. At the outset of this analysis, however, some of the limitations of this data must be emphasized.

First, the level of NFIRS reporting varied from state to state. Montana and California, for example, both had rates of participation that exceeded 59 percent while some states, such as Texas (17 percent), had exceptionally low levels of participation. Beyond this issue, the level of detail given to NFIRS reporting was also of varied quality. Wyoming, for example, had an impressively low proportion of unclassified data entries. Other states were less rigorous. All of these factors combine to make an analysis of regional fire experience an uneven undertaking. Readers should bear this in mind during the course of their review. Despite these limitations, the information contained in this analysis marks the threshold of an important achievement concerning regional fire information. We hope participating and non-participating states will both see the benefits of careful and comprehensive NFIRS reporting from the information provided in this analysis.

1983 FIRE RECORD

In 1983, participating fire departments throughout Region IV reported 296,565 total incidents. From these incidents, 729 deaths to civilians and 2 among fire fighters took place. In addition, 6,967 injuries (2,822 suffered by fire fighters) were reported. Regional data on property losses resulting from any of these incidents are not available through this analysis.

As in other areas of the country, the fire problem in Region IV was concentrated in structure incidents. However, Region IV had a lower proportion of structure fires (30.3 percent) than in some parts of the nation (the U.S. average rate of incidence was 35.8 percent). Fewer deaths stemming from structural fires were reported in Region IV—63.2 percent compared to 77.6 percent for the nation. Nonetheless, the proportion of structural fire deaths was considerably higher than any other fire situation in Region IV. Another critical element of the fire problem—vehicle incidents—had roughly the same level of incidence (25.1 percent) as the national average (24.6 percent). However, the proportion of deaths attributable to these incidents was substantially larger than for the nation as a whole (31.7 percent compared to 19.0 percent). Fires in trees, brush, and grasslands (22.5 percent) also occurred slightly more often than the national average (19.9 percent). A complete listing of fire situations found throughout Region IV is provided in Table 8.10.

Additional insights about regional patterns can be made by reviewing fire incidence by categories of fixed property use. Table 8.11 provides a comparative breakdown of this information. Looking at the national average, it becomes evident that fires in special properties—roadways, construction sites, outdoor areas, and other such locales—were the most common types of incident reported (46.9 percent of total). In Region IV, special property fires took place even more frequently. In 1983, 54.7 percent of the regional incidents reported to NFIRS fell in this category as did 34.5 percent of the fatalities (compared to 19.1 percent for the nation). In turn, the proportions of deaths (59.0

percent) and fires (28.8 percent) in residential property were lower in Region IV than in the nation (72.6 percent and 30.3 percent respectively).

ELEMENTS OF FIRE INCIDENCE

Additional analysis of fire activity in Region IV can be accomplished by using NFIRS data to examine three important causal factors of fire incidence: the equipment involved in a fire's ignition; the form of material first ignited; and the ignition factor. Table 8.12 summarizes the principal findings concerning this data and is followed by a brief, descriptive overview. A detailed discussion of causal elements on a state-by-state basis is provided in subsequent sections of the regional analysis.

FIRE INCIDENCE IN REGION IV, BY SITUATION FOUND

State	NFIRS Fires	NFIRS Deaths	Structure Fires		Vehicle Fires		Trees, Grass, Brush Fires		Refuse Fires		Other Fires*		Unclassified	
			Fires %	Deaths %	Fires %	Deaths %	Fires %	Deaths %	Fires %	Deaths %	Fires %	Deaths %	Fires %	Deaths %
Alaska	3,214	27	46.2%	88.9%	32.0%	11.1%	11.2%	0.0%	6.7%	0.0%	4.0%	0.0%	—	—
California	155,892	356	27.2%	50.8%	28.6%	42.4%	20.7%	3.1%	18.6%	.8%	4.9%	2.8%	—	—
Colorado	7,810	13	30.1%	76.9%	20.9%	15.4%	12.3%	0.0%	32.6%	0.0%	4.1%	7.7%	—	—
Hawaii	6,602	17	12.0%	52.9%	17.5%	47.1%	42.2%	0.0%	25.4%	0.0%	2.9%	0.0%	—	—
Idaho	4,377	10	43.0%	90.0%	15.4%	10.0%	27.7%	0.0%	9.0%	0.0%	4.9%	0.0%	—	—
Montana	5,278	15	37.6%	93.3%	13.2%	6.7%	34.0%	0.0%	10.5%	0.0%	4.6%	0.0%	—	—
Oregon	14,319	61	53.5%	72.1%	25.1%	21.3%	11.4%	1.6%	4.7%	0.0%	5.3%	4.9%	—	—
Texas	66,754	165	25.9%	75.2%	22.4%	23.6%	27.9%	0.0%	20.0%	0.0%	3.8%	1.2%	—	—
Utah	6,880	23	28.5%	69.6%	19.9%	21.7%	34.0%	0.0%	12.7%	0.8%	4.7%	8.7%	—	—
Washington	23,079	39	48.6%	66.7%	19.4%	23.1%	17.6%	0.0%	9.5%	0.0%	4.9%	10.3%	—	—
Wyoming	2,360	5	36.6%	100.0%	19.2%	0.0%	26.9%	0.0%	11.9%	0.0%	5.2%	0.0%	—	—
Region IV	296,565	731	30.3%	63.2%	25.1%	31.7%	22.5%	1.6%	17.5%	.4%	4.6%	3.0%	—	—
U.S.	767,310	2,298	35.8%	77.6%	24.6%	19.0%	19.9%	.9%	15.8%	.3%	3.8%	2.2%	.05%	—

*Other fires include data from the following categories: outside of structure; explosion; outside spill/leak; other.

Table 8.10

FIRE INCIDENCE IN REGION IV, BY CATEGORY OF FIXED PROPERTY USE

State	NFIRS Fires	NFIRS Deaths	Public, Educational, Institutional		Residential		Commercial, Industrial, Storage		Special		Unclassified	
			Fires %	Deaths %	Fires %	Deaths %	Fires %	Deaths %	Fires %	Deaths %	Fires %	Deaths %
Alaska	3,214	27	3.7%	0.0%	37.9%	81.5%	9.7%	7.4%	46.6%	11.1%	2.2%	0.0%
California	155,892	356	4.5%	1.4%	30.0%	46.1%	9.4%	4.8%	59.2%	47.8%	.9%	0.0%
Colorado	7,810	13	4.4%	0.0%	25.2%	76.9%	7.9%	0.0%	58.2%	15.4%	4.1%	7.8%
Hawaii	6,602	17	7.6%	5.9%	14.8%	41.2%	9.0%	0.0%	68.3%	52.9%	.3%	0.0%
Idaho	4,377	10	2.7%	0.0%	39.2%	80.0%	12.7%	10.0%	33.4%	10.0%	12.0%	0.0%
Montana	5,278	15	2.6%	0.0%	33.4%	93.3%	10.7%	0.0%	53.0%	6.7%	.3%	0.0%
Oregon	14,319	61	3.2%	1.6%	39.7%	67.2%	10.4%	3.2%	46.6%	27.9%	.08%	
Texas	66,754	165	3.6%	0.0%	27.2%	75.2%	9.8%	1.8%	56.0%	21.8%	3.5%	1.3%
Utah	6,880	23	3.8%	4.3%	26.0%	43.4%	10.7%	21.7%	45.4%	26.1%	14.3%	4.3%
Washington	23,079	39	4.5%	0.0%	46.5%	69.2%	8.9%	5.1%	29.6%	17.9%	10.5%	7.7%
Wyoming	2,360	5	3.6%	0.0%	33.5%	80.0%	13.8%	20.0%	44.8%	0.0%	4.3%	0.0%
Region IV	296,565	731	4.2%	1.1%	28.8%	59.0%	9.6%	4.5%	54.7%	34.5%	2.8%	1.0%
U.S.	767,310	2,298	3.7%	1.4%	30.3%	72.6%	9.7%	4.6%	46.9%	19.1%	9.3	2.2

Table 8.11

CAUSAL FACTORS OF REGION IV FIRES

Equipment Involved in Ignition {1}	Fires	Deaths
—Heating Systems	6.7%	10.4%
—Cooking Equipment	5.4%	3.7%
—Electrical Distribution	6.1%	4.0%
—Other Remaining Categories of Equipment	9.6%	3.2%
—No Equipment/Vehicle/Non-Standard Equipment	60.0%	64.3%
—Unknown/Blank/Invalid	12.2%	14.4%
Total	100.0%	100.0%

Form of Material Involved in Ignition	Fires	Deaths
—Structural Framework	7.1%	7.0%
—Power Transformation	21.8%	17.6%
—General Form (Grass, Trash)	43.4%	3.7%
—Furniture/Soft Goods/Apparel	8.5%	27.1%
—Other Remaining Categories	12.1%	28.5%
—Unknown/Blank/Invalid	7.1%	16.1%
Total	100.0%	100.0%

Ignition Factor	Fires	Deaths
—Misuse of Heat	19.7%	25.2%
—Mechanical Failure	23.3%	10.0%
—Operational Deficiency	7.0%	14.8%
—Misuse of Material		
—Arson (Incendiary, Suspicious)	21.5%	20.2%
—Other Remaining Categories	14.0%	11.1%
—Unknown/Blank/Invalid	14.5%	18.7%
Total	100.0%	100.0%

Table 8.12

According to the NFIRS national average, over half (52.1 percent) the fires reported in 1983 were started by factors other than *equipment involvement in ignition*. In Region IV an even higher incidence of fires were ignited by non-equipment factors (60.0 percent). In instances where equipment was involved in ignition, heating systems (6.7 percent of the total), electrical distribution equipment (6.1 percent), cooking equipment (5.4 percent), and special equipment (5.2 percent) had the largest proportions of incidence in the region.

Throughout the United States, including Region IV, the most common *forms of materials ignited* were trees, grass, rubbish, trash, and other general form materials. In Region IV, these fires represented 43.4 percent of the NFIRS incidents (compared to 37.7 percent nationally). Second ranking in terms of incidence were fires where power transformation equipment or fuel ignited. Fires involving these materials represented 21.8 percent of the incidents and were implicated in 10.5 percent of the NFIRS-reported deaths. Less frequent but more imposing in terms of loss of human life were fires where furniture, soft goods, or apparel were ignited. These fires, which fortunately had only an 8.5 percent rate of incidence, constituted 27.1 percent of the deaths.

SUMMARY

Fire activity in Region IV was largely in keeping with national patterns. Some deviation from national averages was found. However, to some extent, variations can be explained by the geographic make-up of the region. Consider, for example, the slightly higher incidence of fire situations involving trees, brush, and grasslands. The vast wilderness that is typical of many parts of this region means that an above average incidence of outdoor fires could readily be anticipated for the region.

As the preceding table indicates, according to the NFIRS national average, 18.9 percent of the fires reported in 1983 had heating, cooking, or electrical distribution equipment involved in their ignition. In Region IV the same trend exists—that is heating, cooking, or electrical distribution equipment involved in their ignition. In Region IV, the greatest number of fires had no equipment involved in ignition—(60.0 percent) a substantially higher percentage than the national average (38.2 percent).

ALASKA

Over three-fourths (39.4 percent) of the 218 registered fire departments in Alaska submitted data to the National Incident Reporting System (NFIRS) in 1983. During this period, departments reported the incidence of 3,214 fires. These incidents resulted in 27 fire-related deaths (none among fire fighters) and 112 injuries (42 sustained by fire fighters). As in other states, Alaska's fire problem is concentrated in structure-based incidents. Moreover, according to NFIRS reports, Alaska has one of the highest rates of structural fire occurrence (46.2 percent) in the region. This problem is particularly critical given the large proportion of deaths attributable to structure fires—88.9 percent. A comparative listing of fire situations found in Alaska and other states in Region IV is provided in Table 8.10.

A look at Alaska's fire incidence by categories of fixed property use indicates that most fires in Alaska occur in special properties; e.g., outdoors; abandoned structures; rail and roadways. In 1983, 46.6 percent of the state fires and three of the twenty-seven deaths reported to NFIRS took place in this category. More severe in terms of casualties were fires that occurred in residential properties, which represented 81.5 percent of the NFIRS-reported deaths. A complete list of fires by fixed property use for Alaska and other Region IV states is presented in Table 8.11.

ELEMENTS IN FIRE INCIDENCE

Further analysis of Alaska's fire activity can be undertaken by using NFIRS data to examine three major causal elements of fire incidence: the equipment involved in fire ignition; the form of material ignited; and ignition factors. Table Alaska-1 summarizes these data findings and is followed by a brief descriptive overview.

TABLE ALASKA-1

CAUSAL FACTORS OF ALASKA FIRES

Equipment Involved in Ignition {1}	Fires	Deaths
—Heating Systems	15.1%	25.9%
—Cooking Equipment	5.2%	0.0
—Electrical Distribution Equipment	5.5%	3.7%
—Service/Maintenance Equipment	3.2%	3.7%
—Other/No Equipment	41.7%	11.1%

Form of Material Ignited {2}	Fires	Deaths
—Structural Framework	13.6%	7.4%
—Power Transformation	19.7%	11.1%
—General Form	27.3%	0.0
—Furniture/Soft Goods/Apparel	8.1%	11.1%

Ignition Factor {3}	Fires	Deaths
—Misuse of Heat	17.9%	18.5%
—Mechanical Failure	22.2%	3.7%
—Operational Deficiency	9.6%	0.0
—Arson (Incendiary, Suspicious)	11.6%	0.0

{Note 1} In 23.4% of all incidents, "Equipment Involved in Ignition" was either unknown or left blank.

{Note 2} In 17.0% of all incidents, "Form of Material Ignited" was either unknown or blank.

{Note 3} In 23.4% of all incidents, "Ignition Factor" was either unknown or left blank.

In 34.8 percent of the Alaskan fires reported to NFIRS, *equipment was involved in ignition.*[55] The leading type of equipment involved in the state's fire incidents was heating systems, implicated in 15.1 percent of the fires and 25.9 percent of the deaths. Other categories of equipment are listed in the preceding table. However, it is important to emphasize that in most Alaskan incidents (41.7 percent)—as in other states—no standard forms of equipment were *involved in ignition.* Instead, other factors were at hand. For example, in some instances, fires may have been ignited through vehicle involvement; and, more than likely, if Alaska follows the same pattern as other states, no equipment was involved in the ignition of many fires. Analysts speculate that these "equipment-less" fires frequently are started by a careless smoker's match, lighter, or other material.

The principal *forms of material ignited* in Alaskan fires—as in other states—are what is known as general form materials; e.g., trees, grass, rubbish, and trash.[56] In Alaska, 27.3 percent of the state's NFIRS incidents involved general form materials. No deaths were reported from such fires. Second ranking in terms of incidence were fires where power transformation materials ignited (19.7 percent of NFIRS incidents). These fires were implicated in 11.1 percent of the state's NFIRS-reported deaths.

[55]In 23.4 percent of the incidents and 51.9 percent of the deaths, equipment involvement was either unknown or unclassified by Alaskan NFIRS respondents. Because of this, data findings pertaining to this topic may be of limited accuracy and, clearly, are not fully representational.

[56]In 70.0 percent of the incidents and 70.4 percent of the deaths, the form of material was either unknown or unclassified by Alaskan NFIRS respondents. As a result, findings pertaining to this topic may not be fully representational.

Based on NFIRS reports, the leading *ignition factor* in Alaskan fires was mechanical failure; e.g., part malfunction and short circuits.[57] Fires where this ignition factor was involved represented 22.2 percent of the incidents and were implicated in one (3.7 percent) death. Fires involving the misuse of heat of ignition, while slightly less common (17.9 percent), were far more deadly (18.5 percent). Of these, fires involving abandoned materials (7.6 percent) and children playing (3.9 percent) were most frequent.

CASUALTY SUMMARY

The risk of casualty—including both injury and death—from Alaska's fires has increased in the past several years. For civilians, in 1982 the number of casualties was 25.0 per 1,000 fires compared to 30.2 in 1983. Looking solely at structure fires, the number rose from 54.2 casualties per 1,000 structure fires in 1982 to 65.4 in 1983.

Among fire fighters a similar pattern is observed. In 1982, the general level of risk was 8.7 casualties per 1,000 fires compared to 13.1 in 1983. In terms of structure fires, the number increased from 18.8 per 1,000 structure fires to 28.3 in 1983.

CALIFORNIA

In 1983, 667 (59.7 percent) of the 1,117 registered fire departments in California submitted data to the National Fire Incident Reporting System (NFIRS). During this period, California departments reported the incidence of 155,892 fires. As a result of some of these fires, 356 deaths took place (including two fire fighter victims) and 2,791 injuries (935 of which were suffered by fire fighters) were reported.

The situations found by responding fire fighters for any given incident provides valuable information about the characteristics of fire activity. For example, when a state's NFIRS respondents submit data about each fire situation, this information can be aggregated to determine the overall fire activity for the state. NFIRS data for the nation indicates that in most states the most common situations reported by fire departments were structure fire incidents. California is an exception: in 1983, according to NFIRS reports, it was one of the few states where vehicle fires (28.5 percent) had a higher proportion of incidence than structure fires (27.2 percent). Moreover, the percentage of structure fires in California was considerably lower than national (35.8 percent) and regional (30.3 percent) averages. A comparative listing of situations found in California and other states in Region IV is provided in Table 8.10.

An exploration of fire incidence by categories of fixed property use indicates that California also has a lower rate of residential property fires (30.0 percent) than that of many other states. In turn, the proportion of special property fires (59.2 percent of all state NFIRS incidents) is considerably higher as is the incidence of deaths resulting from these fires (47.8 percent). A comparative listing of fire incidence by fixed property category in California and other states in Region IV is presented in Table 8.11.

ELEMENTS OF FIRE INCIDENCE

Further analysis of California's fire activity can be undertaken by using NFIRS data to examine three major causal elements of the fire problem: the equipment involved in fire

[57] In 23.4 percent of the incidents, the ignition factor was either not known or not reported by Alaskan NFIRS respondents. As a result, these findings may not be fully representational.

ignition; the form of material ignited; and the ignition factors. The findings of this analysis are summarized in Table California-1 and are followed by a brief descriptive overview.

TABLE CALIFORNIA-1

CAUSAL FACTORS OF CALIFORNIA FIRES

Equipment Involved in Ignition {1}	**Fires**	**Deaths**
—Heating Systems	3.8%	4.8%
—Cooking Equipment	5.9%	4.2%
—Electrical Distribution Equipment	6.9%	4.2%
—Special Equipment	7.7%	0.3%
—Other/No Equipment	58.5%	73.3%
Form of Material Ignited {2}	**Fires**	**Deaths**
—Structural Framework	5.5%	3.1%
—Power Transformation	23.7%	18.8%
—General Form	41.8%	3.7%
—Furniture/Soft Goods/Apparel	9.3%	24.4%
Ignition Factor {3}	**Fires**	**Deaths**
—Misuse of Heat	20.0%	20.8%
—Mechanical Failure	25.5%	9.8%
—Operational Deficiency	6.0%	13.8%
—Arson (Incendiary, Suspicious)	25.1%	32.6%

{Note 1} In 13.1% of all incidents "Equipment Involved in Ignition" was either unknown or left blank.

{Note 2} In 7.3% of all incidents "Form of Material Ignited" was either unknown or left blank.

{Note 3} In 10.1% of all incidents, "Ignition Factor" was either unknown or left blank.

As in other states, most fires in California are not started by equipment involved in ignition.[58] In 1983, 58.5 percent of all California's NFIRS-reported fires (resulting in 73.3 percent of all deaths) began by either other non-standard equipment factors; e.g., vehicular involvement, or by no equipment whatsoever. In the latter case, fires are ignited by matches, lighters, and other non-equipment classifications. Analysts speculate that many of these fires—which generally comprise a comparatively large proportion of incidence—are often started by careless smoking practices. In fires where standard types of equipment were involved in ignition, the leading contributor was special equipment, which was implicated in the ignition of 7.7 percent of all state NFIRS fires. Fortunately, fires that started from special equipment resulted in only a 0.8 percent incidence of deaths.

[58]In 13.1 percent of NFIRS incidents, the equipment involved in ignition was either unknown or unclassified. As a result, findings in this category may not be fully representational.

In California, as in other states, the principal *form of material ignited* was the so-called general form, which includes grass, trees, rubbish, and trash.[59] During 1983, state fire departments reported 65,124 such incidents, which represented 41.8 percent of the total. Fires involving general form materials tend to have a low rate of casualty. In 1983, 3.7 percent of the NFIRS-reported deaths occurred in this category. Far less frequent, but considerably more deadly, were fires involving furniture, soft goods/apparel fires (9.3 percent of total incidence), which collectively represented 24.4 percent of the NFIRS-reported deaths. Another dangerous type of fire involves the ignition of power transformation equipment or fuel. In California, such fires had a rate of incidence of 23.7 percent and were implicated in 18.8 percent of the NFIRS-recorded deaths.

The leading *ignition factor* in California fires was mechanical failure (25.5 percent of NFIRS incidents and 9.8 percent of deaths).[60] Only slightly less frequent and far more deadly were arson-related fires (25.1 percent of total incidence), which were implicated in 32.6 percent of the state's reported fire deaths.

CASUALTY SUMMARY

The overall level of risk of casualty from fires in California decreased moderately during the past several years. Among civilians, the number of casualties per 1,000 fires was 16.2 in 1982 compared to 14.2 in 1983. In terms of structure fires—generally associated higher incidents of casualty—the amount decreased from 57.4 casualties per 1,000 structure fires in 1982 to 52.0 in 1983.

For fire fighters, the number decreased from 8.1 per 1,000 fires in 1982 to 6.0 in 1983. Looking solely at structure fires, the amount declined from 28.7 per 1,000 fires in 1982 to 22.0 in 1983.

COLORADO

During 1983, 7,810 incidents were reported to the National Fire Incident Reporting System (NFIRS) by Colorado fire departments. In this period, thirteen fire-related deaths (none among fire fighters) and 602 injuries (including 332 injured fire fighters) were recorded.

A look at fire incidence in Colorado by the category of situation found by on-the-scene fire fighters is revealing. Based on NFIRS data, refuse fires—representing 32.6 percent of the total incidents reported—outnumbered all other types of fire in Colorado. Nonetheless, as in other states, the core of Colorado's fire problem is the structure fire, which constitutes 30.1 percent of the state's NFIRS incidents and 76.9 percent of its fire deaths. A complete listing of fire activity in Colorado and other states in Region IV is provided in Table 8.10.

Analysis of Colorado fire activity by categories of fixed property use provides additional insights. Special property fires—always associated with a comparatively high rate of incidence—represented a particularly large proportion of Colorado's fires (58.2 percent). Slightly over 15 percent (15.4) of the state's NFIRS-reported deaths occurred in this category. The most critical category of fixed property was that involving residen-

[59]In 7.3 percent of California's NFIRS fires, the form of material was either unknown or unclassified.

[60]In 10.1 percent of the fires, the ignition factor was either unknown or unclassified by California NFIRS respondents. As a result, findings pertaining to this topic may not be fully representational.

fires—25.2 percent of all NFIRS incidents and 76.9 percent of the NFIRS-reported deaths. A complete listing of fire incidence by fixed property use in Colorado and other Region IV states is provided in Table 8.11.

ELEMENTS OF FIRE INCIDENCE

Further analysis of Colorado fires can be undertaken by using NFIRS data to examine three important elements of fire incidence: the equipment involved in fire ignition; the form of materials ignited; and the ignition factors. Table Colorado-1 provides a summary of these data findings and is followed by a brief descriptive overview.

TABLE COLORADO-1

CAUSAL FACTORS OF COLORADO FIRES

Equipment Involved in Ignition {1}	**Fires**	**Deaths**
—Heating Systems	4.2%	7.7%
—Cooking Equipment	6.8%	7.7%
—Electrical Distribution Equipment	4.6%	0.0
—Special Equipment	8.3%	0.0
—Other/No Equipment	57.8%	38.5%
Form of Material Ignited {2}	**Fires**	**Deaths**
—Structural Framework	6.1%	15.4%
—Power Transformation	19.0%	15.4%
—General Form	51.5%	0.0
—Furniture/Soft Goods/Apparel	10.2%	46.2%
Ignition Factor {3}	**Fires**	**Deaths**
—Misuse of Heat	25.3%	23.1%
—Mechanical Failure	19.5%	15.4%
—Operational Deficiency	5.7%	7.7%
—Arson (Incendiary, Suspicious)	21.7%	15.4%

{Note 1} In 14.2% of all incidents, "Equipment Involved in Ignition" was either unknown or left blank.

{Note 2} In 2.2% of all incidents, "Form of Material Ignited" was either unknown or left blank.

{Note 3} In 18.6% of all incidents, "Ignition Factor" was either unknown or left blank.

As the preceding table indicates, in Colorado fires where *equipment was involved in ignition*, the leading factor was special equipment, which was an element in 8.3 percent of the state's NFIRS incidents.[61] Second-ranking were fires ignited by cooking equipment —particularly surface units. Such fires, which were involved in 6.8 percent of all NFIRS incidents, were implicated in one death. Interestingly, more often than not, other factors not associated with standard categories of equipment, such as vehicle involvement,

[61]In 14.2 percent of the incidents and 38.5 percent of the deaths, the equipment involved in ignition was either not known or not classified by Colorado NFIRS respondents. As a result, these data findings may not be fully representational.

contributed to fire ignition. In Colorado, 57.8 percent of the incidents and 38.5 percent of the deaths resulted from such fires. Of these, 51.0 percent were started by no equipment. Analysts speculate that many of these "equipment-less" fires were ignited by matches, lighters, and other paraphernalia of careless smokers.

Over half (51.5 percent) of the fires in Colorado involved the ignition of "general form" materials; e.g., trees, grass, rubbish, and trash. No deaths were reported in this category of fire.[62] The second ranking *form of material ignited* was power transformation equipment and fuel, which represented 19.0 percent of the NFIRS incidents and 15.4 percent of the deaths. Less frequent but substantially more threatening to human life were fires where furniture, soft goods, and apparel ignited. Collectively these fires, which represented 10.2 percent of the NFIRS incidents, were implicated in 46.2 percent of the deaths in Colorado.

The leading *factor of ignition* in Colorado fires was misuse of heat of ignition (particularly involving incidents of children playing); these fires accounted for 25.3 percent of the NFIRS incidents and 23.1 percent of the deaths.[63] Another prominent factor was arson. Over one-fifth (21.7 percent) of the state's NFIRS incidents and 15.4 percent of the deaths occurred as a result of incendiary or suspicious ignition factors.

CASUALTY SUMMARY

Based on NFIRS data reports, casualty risks have increased for Colorado's fire fighters and decreased for civilians during the past several years. In 1982, the number of casualties among civilians per 1,000 fires was 46.9 compared to 42.9 in 1983. Looking solely at structure fires, the amount decreased from 122.0 per 1,000 structure fires in 1982 to 107.8 in 1983.

Among fire fighters, the number rose from 5.6 casualties per 1,000 fires in 1982 to 13.3 in 1983. In terms of structure fires, the level increased from 14.6 casualties per 1,000 structure fires to 33.5 in 1983.

HAWAII

Eighty-five of the state's registered fire departments in Hawaii submitted data to the National Fire Incident Reporting System (NFIRS) during 1983. In this period, departments recorded the incidence of seventeen fire-related deaths—all of the victims were civilians—and 228 injuries (159 of which were suffered by fire fighters). While fire activity in this state largely follows national trends (See Table 8.10), unlike most other states, Hawaii had a comparatively low incidence of structural fires (12.0 percent of NFIRS incidents). If data entries were accurately reported, Hawaii's structure fires were considerably less frequent than regional (30.3 percent) and national (35.8 percent) averages. In turn, the incidence of fires in trees, grass, and brush (42.1 percent) was substantially higher than proportional averages for Region IV (22.5 percent) and the nation (19.9 percent). Fortunately, no loss of human life seems to have resulted from the state's outdoor fires.

[62]In 2.2 percent of Colorado's NFIRS fires, the form of material ignited was either unknown or unclassified. As a result, these findings may not be fully representational.

[63]In 18.6 percent of Colorado's NFIRS fires, the ignition factor was either unknown or unclassified. As a result, these findings may not be fully representational.

A comparative exploration of fire activity by categories of fixed property use (See Table 8.11) reveals a similar pattern. In 1983, Hawaii had a far lower proportion of residential property fires (14.6 percent) than those of the region (28.8 percent) and the nation as a whole (30.3 percent). Deaths resulting from such fires also reflected a smaller proportion of incidence in Hawaii (41.2 percent) when compared to the region (59.1 percent) and the nation (72.6 percent). Fires in special properties—including vacant structures, construction sites, roadways, and other designated areas—had a much larger rate of frequency in Hawaii (68.2 percent) and a higher incidence of death (52.9 percent) than the region (54.7 and 34.5 percent respectively) and the nation (46.9 and 19.1 percent).

ELEMENTS OF FIRE INCIDENCE

Further understanding of Hawaii's 1983 fire experience can be achieved by using NFIRS data to analyze three major causal elements of fire incidence: the equipment involved in fire ignition; the form of materials first ignited; and the ignition factors. Table Hawaii-1 summarizes principal findings pertaining to this topic and is followed by a brief descriptive overview.

TABLE H-1

CAUSAL FACTORS IN HAWAII FIRES

Equipment Involved in Ignition {1}	**Fires**	**Deaths**
—Heating Systems	.5%	0.0
—Cooking Equipment	2.7%	5.9%
—Electrical Distribution Equipment	1.3%	0.0
—Other/No Equipment	93.7%	88.2%
Form of Material Ignited {2}	**Fires**	**Deaths**
—Structural Framework	4.3%	11.8%
—Power Transformation	11.7%	41.2%
—General Form	74.6%	11.8%
—Furniture/Soft Goods/Apparel	5.2%	23.5%
Ignition Factor {3}	**Fires**	**Deaths**
—Misuse of Heat	18.4%	17.6%
—Mechanical Failure	11.9%	11.8%
—Operational Deficiency	3.4%	35.3%
—Arson (Incendiary, Suspicious)	54.9%	29.4%

{Note 1} In .1% of all incidents, "Equipment Involved in Ignition" was either unknown or left blank.

{Note 2} In .7% of all incidents, "Form of Material Ignited" was either unknown or blank.

{Note 3} In 4.7% of all incidents, "Ignition Factor" was either unknown or left blank.

The proportion of fires that are started by *equipment involved in ignition* tends to be surprisingly low in states throughout the nation.[64] More often it is other factors, such as vehicle involvement, that cause ignition to occur. Hawaii's fire experience is particularly illustrative of this pattern. In 1983, only about 6.2 percent of the NFIRS incidents were the result of equipment ignition. In turn, 93.6 percent of the Hawaii fires reported to NFIRS were started by other factors besides standard categories of equipment. Of these, 91.0 percent were ignited without any equipment involvement. Analysts speculate that many of these "equipment-less" fires occur from the ignition of matches, lighters, and other paraphernalia of careless smokers.

In Hawaii, as in other states, trees, grass, rubbish, trash, and other such materials were the principal *form of materials ignited.*[65] These materials—known as "general form"—were involved in 74.6 percent of the Hawaii NFIRS fires. Less frequent but more threatening to human life were fires where furniture, soft goods, and apparel ignited. Fires of this nature were implicated in four of the state's seventeen deaths. Even more deadly were fires involving power transformation equipment and fuel; these resulted in seven deaths (41.2 percent of the state's NFIRS-reported deaths).

The leading *ignition factors* in Hawaii fires were incendiary and suspicious—both arson-related.[66] Collectively representing 54.9 percent of the state's incidents, these factors had a much higher proportion of incidence than averages for the region (21.4 percent) and the nation (17.0 percent). Moreover, arson-related fires were implicated in five (29.4 percent) of Hawaii's deaths.

CASUALTY SUMMARY

Casualties from fires in Hawaii have increased for fire fighters and decreased for civilians during the past few years. In 1982, the number of casualties among fire fighters was 21.6 per 1,000 fires compared to 24.1 in 1983. Looking solely at structure fires, the increase is considerably more sizable. In 1982, the number was 130.1 per 1,000 structure fires compared to 200.3 casualties in 1983.

Among civilians, the level declined from 19.2 casualties per 1,000 fires in 1982 to 13.0 in 1983. In terms of structure fires, the number declined from 115.6 casualties per 1,000 structure fires to 108.3 in 1983.

IDAHO

In 1983, 87 of Idaho's 202 registered fire departments submitted data to the National Fire Incident Reporting System (NFIRS). During this period, Idaho departments reported a total of 4,377 incidents, ten deaths (all civilian victims), and 127 injuries (64 suffered by fire fighters). Based on NFIRS data, fire activity in Idaho is firmly concentrated in structure incidents. Slightly less than one-half (43.0 percent) of the NFIRS

[64]In .1 percent of the NFIRS incidents, the equipment involved in ignition was either unknown or unclassified. As a result, these figures in this category should be fairly representational.

[65]In .7 percent of Hawaii's NFIRS fires, the form of material was either unknown or unclassified. As a result, findings will be fairly representational.

[66]In 4.7 percent of the incidents, the ignition factor was either unknown or unclassified. As a result, findings may not be representational.

incidents and 90.0 percent of the deaths were structure fires. As Table 8.10 indicates, the proportion of structure fire incidence in Idaho is higher than regional (30.3 percent) and national (35.8 percent) averages.

An examination of fire activity by categories of fixed property use in Idaho reveals a large proportion of fires in residential property (39.2 percent). Eight of the state's ten NFIRS-reported deaths were the result of residential incidents. A major problem for all states, residential fires are a particularly critical component of Idaho's fire activity. The rate of incidence was higher than both regional (28.8 percent) and national (30.3 percent) averages. A complete listing of fire incidence by fixed property use in Idaho and other Region IV states is provided in Table 8.11.

ELEMENTS OF FIRE INCIDENCE

Further analysis of fire activity in Idaho can be accomplished by using NFIRS data to examine three major causal elements of fire incidence: the equipment involved in fire ignition; the form of materials first ignited; and the ignition factors. Table Idaho-1 summarizes key findings pertaining to this topic and is followed by a brief, descriptive overview.

TABLE I-1

CAUSAL FACTORS IN IDAHO FIRES

Equipment Involved in Ignition {1}	**Fires**	**Deaths**
—Heating Systems	19.6%	10.0%
—Cooking Equipment	3.9%	0.0
—Electrical Distribution Equipment	4.8%	0.0
—Other/No Equipment	59.8%	80.0%
Form of Material Ignited {2}	**Fires**	**Deaths**
—Structural Framework	10.8%	20.0%
—Power Transformation	12.3%	0.0
—General Form (Grass, Trash)	55.1%	10.0%
—Furniture/Soft Goods/Apparel	6.3%	30.0%
Ignition Factor {3}	**Fires**	**Deaths**
—Misuse of Heat	22.0%	20.0%
—Mechanical Failure	17.9%	10.0%
—Operational Deficiency	17.3%	0.0
—Arson (Incendiary, Suspicious)	12.4%	0.0

{Note 1} In 5.1% of all incidents, "Equipment Involved in Ignition" was either unknown or left blank.

{Note 2} In 2.8% of all incidents, "Form of Material Ignited" was either unknown or left blank.

{Note 3} In 10.1% of all incidents, "Ignition Factor" was either unknown or left blank.

As Table Idaho-1 indicates, a little over half (59.8 percent) of the NFIRS incidents in Idaho began from factors other than *equipment involved in ignition.*[67] This pattern is in keeping other states' fire experience. Analysts speculate that many of the fires ignited with no equipment involvement are started by the careless use of matches, lighters, and other smoking materials. In 34.6 percent of the fires reported in Idaho, equipment was a source of ignition. In these incidents, heating systems—which represented 19.6 percent of the incidents—had the highest proportion of involvement.

As in other states, trees, grass, rubbish, trash, and other types of general form materials were the most frequent *form of materials ignited.*[68] Fires involving these materials represented 55.1 percent of the state's NFIRS fires and were implicated in one fire-related death.

The leading *ignition factor* in Idaho fires was misuse of heat of ignition, particularly when open fire or abandoned material was involved.[69] Such fires constituted 22.0 percent of the state's NFIRS incidents and were implicated in two of the ten fire deaths. Other critical factors in Idaho were mechanical failure, which was an element of ignition in 17.9 percent of the incidents, and operational deficiencies, which were involved in 17.3 percent.

CASUALTY SUMMARY

The risk of casualty from Idaho fires have declined slightly for fire fighters and increased for civilians. In 1982, the number of casualties among fire fighters was 15.3 per 1,000 fires compared to 14.6 in 1983. Looking only at structure fires, the level of incidence dropped from 36.2 casualties per 1,000 fires in 1982 to 34.0 casualties in 1983.

Among civilians, the number of casualties rose from 13.3 per 1,000 fires in 1982 compared to 16.7 in 1983. In terms of structure fires, the level of casualties increased from 31.5 per 1,000 fires in 1982 to 38.8 in 1983.

MONTANA

More than 60 percent (62.7) of the 365 registered fire departments in Montana submitted data to the National Fire Incident Reporting System (NFIRS) in 1983. During the year, Montana departments reported 5,278 incidents, fifteen fire-related deaths (none among fire fighters), and 80 injuries (35 involving fire fighters). The most common fire situations found by Montana fire departments—as in many other states—were structure incidents. However, Montana departments reported a little higher incidence of structure fires (37.7 percent) than the averages for the region (30.3 percent) and the nation (35.8 percent). More critically, fourteen of Montana's fifteen NFIRS-reported fire deaths (93.3 percent) took place as a result of structure incidents. This was a larger proportion of fatalities than was experienced by the region (63.2 percent) or the nation (77.6 percent).

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[67]In 5.1 percent of the NFIRS incidents, the equipment involved in ignition was either unknown or unclassified. As a result, the findings in this category may not be representational.

[68]In 2.8 percent of Idaho's NFIRS fires, the form of material ignited was either unknown or unclassified. As a result, these findings may not be fully representational.

[69]In 10.1 percent of the incidents and 50.0 percent of the deaths, the ignition factor was either unknown or unclassified by Idaho NFIRS respondents. As a result, findings pertaining to this topic may not be fully representational.

Table 8.10 provides a detailed breakdown of fire situations found in Montana and other states in Region IV.

An examination of Montana fire activity by categories of fixed property use indicates that the greatest percentage of incidence occurred in special properties; e.g., outdoor areas, roadways, and other designated properties. In 1983, 53.0 of the state's NFIRS incidents fell in this category—a proportion generally in keeping the regional average (54.7 percent). One death resulted from a special property incident. In turn, residential property fires, which represented 33.4 percent of Montana's incidents, were implicated in 93.3 percent of the state's NFIRS-reported fire deaths. A complete listing of fire incidence by fixed property use categories in Montana and other states in Region IV is presented in Table 8.11.

ELEMENTS OF FIRE INCIDENCE

Further analysis of Montana fire activity can be conducted by using NFIRS data to explore three major elements of fire incidence: the equipment involved in a fire's ignition; the form of material first ignited; and the ignition factor. Table Montana-1 summarizes this data and a brief, descriptive overview follows:

TABLE M-1

CAUSAL FACTORS OF MONTANA FIRES

Equipment Involved in Ignition {1}	**Fires**	**Deaths**
—Heating Systems	18.0%	40.0%
—Cooking Equipment	3.1%	6.7%
—Electrical Distribution Equipment	4.0%	0.0
—Other/No Equipment	66.5%	46.7%
Form of Material Ignited {2}	**Fires**	**Deaths**
—Structural Framework	11.0%	13.3%
—Power Transformation	10.8%	0.0
—General Form (Grass, Trash)	50.5%	40.0%
—Furniture/Soft Goods/Apparel	5.4%	13.3%
Ignition Factor {3}	**Fires**	**Deaths**
—Misuse of Heat	19.0%	33.3%
—Mechanical Failure	25.1%	20.0%
—Operational Deficiency	8.0%	0.0
—Arson (Incendiary, Suspicious)	10.1%	13.3%

{Note 1} In .1% of all incidents, "Equipment Involved in Ignition" was either unknown or left blank.

{Note 2} In 7.8% of all incidents, "Form of Material Ignited" was either unknown or left blank.

{Note 3} In 20.6% of all incidents, "Ignition Factor" was either unknown or left blank.

A look at *equipment involved in the ignition* of Montana fires reveals that heating systems, which represented 18.0 percent of the state's NFIRS incidents and contributed

to 40 percent of the state's fire deaths, was a leading element.[70] The proportion of heating system fires in Montana was substantially higher than the regional (6.7 percent) and national (8.6 percent) averages. As in other states, however, other factors besides standard categories of equipment were the sources of ignition in most Montana incidents. In 1983, 66.5 percent of the state's incidents were ignited by other factors; these fires were implicated in 46.7 percent of Montana's reported deaths. Of these incidents, 57.7 percent were ignited with absolutely no equipment involvement. Analysts speculate that non-equipment incidents often are ignited by the careless use of matches, lighters, and other smoking materials.

As Table Montana-1 indicates, most incidents in the state involved the ignition of general form materials.[71] Rubbish, trash, and particularly trees and grass represented slightly over half (50.5 percent) of the state's NFIRS incidents. This pattern of incidence —while somewhat higher—is generally in line with both regional and national averages. However, general form fires resulted in a larger incidence of death (40.0 percent) than in the region (3.7 percent) and the nation (4.6 percent) overall. As in other states, fires involving the ignition of structural framework, furniture, soft goods, and apparel posed a large threat to human life.

The leading ignition factor in Montana fires was mechanical failure, which was involved in 25.1 percent of the state's NFIRS incidents and 20.0 percent of its deaths.[72] Less frequent in incidence (19.0 percent) but more imposing in terms of loss of life (33.3 percent) were fires where the heat of ignition was misused, particularly in incidents involving abandoned materials, open fires, or children playing. Two of the deaths from Montana fires resulted from incendiary and suspicious fires. However, Montana did have a lower proportion of incidence of arson-related fires (10.1 percent of state NFIRS reports) than regional (21.5 percent) and national (17.3 percent) averages.

CASUALTY SUMMARY

The risk of casualty from Montana fires increased moderately in the past few years. For civilians, the number increased from 9.1 casualties per 1,000 fires in 1982 to 11.4 in 1983. Looking only at structure fires, the number rose from 21.6 per 1,000 structure fires to 30.2 in 1983.

Among fire fighters, general level of risk remained more stable: 6.5 casualties per 1,000 fires in 1982 to 6.6 in 1983. In terms of structure fires, the number increased from 15.3 casualties per 1,000 structure fires in 1982 to 17.6 in 1983.

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[70]In 0.1 percent of the NFIRS incidents, the equipment involved in ignition was either unknown or unclassified. As a result, findings in this category should be fairly representational.

[71]In 7.8 percent of the incidents and 26.7 percent of the deaths, the form of material ignited was either unknown or unclassified by Montana NFIRS respondents. As a result, the findings contained in this section may not be fully representational.

[72]In 20.6 percent of the incidents, the ignition factor was either unknown or unclassified by Montana NFIRS respondents. As a result, findings in this area may not be representational.

OREGON

In 1983, 440 registered fire departments in Oregon submitted data to the National Fire Incident Reporting System (NFIRS). During the year, departments reported a total of 14,319 incidents, 61 fire-related deaths (none among fire fighters), and 580 injuries (252 among fire fighters).

Based on NFIRS data, the core of Oregon's fire problem is firmly positioned in its structure incidents. In 1983, Oregon departments reported the occurrence of 7,661 structure fires—which represented 53.5 percent of the state's NFIRS incidents. This rate of incidence was the highest of the Region IV states and was considerably higher than the national average (35.8 percent). The percentage of deaths resulting from Oregon structure fires (72.1 percent) was slightly less than the national average (77.6 percent) but above the average for Region IV (63.2 percent). As Table 8.10 indicates, the proportion of Oregon fires in trees, brush, and grasslands (11.4 percent of all incidents) was smaller than that of the region (22.5 percent) and the nation (19.9 percent).

A comparative examination of fire incidence by categories of fixed property use (See Table 8.11) indicates that Oregon had a higher incidence of residential fires (39.7 percent) than the averages of the region (28.7 percent) and the nation (30.6 percent). The percentage of deaths resulting from such fires was 67.2 percent for Oregon compared to 59.1 percent for Region IV, and 72.6 percent for the nation as a whole.

TABLE O-1

CAUSAL FACTORS OF OREGON FIRES

Equipment Involved in Ignition {1}	**Fires**	**Deaths**
—Heating Systems	20.9%	19.7%
—Cooking Equipment	6.6%	4.9%
—Electrical Distribution Equipment	14.5%	8.2%
—Other/No Equipment	38.5%	52.5%
Form of Material Ignited {2}	**Fires**	**Deaths**
—Structural Framework	11.1%	13.1%
—Power Transformation	20.6%	18.0%
—General Form	39.6%	1.6%
—Furniture/Soft Goods/Apparel	8.3%	37.7%
Ignition Factor {3}	**Fires**	**Deaths**
—Misuse of Heat	23.9%	44.3%
—Mechanical Failure	25.1%	3.3%
—Operational Deficiency	21.6%	21.3%
—Arson (Incendiary, Suspicious)	8.9%	3.3%

{Note 1} In 4.1% of all incidents, "Equipment Involved in Ignition" was either unknown or left blank.

{Note 2} In 3.2% of all incidents, "Form of Material Ignited" was either unknown or left blank.

{Note 3} In 5.7% of all incidents, "Ignition Factor" was either unknown or left blank.

As in Montana and Washington, in fires where *equipment was involved in ignition*, heating systems had one of the highest proportions of involvement in Oregon[73] (20.9 percent compared to the regional average of 6.7 percent and 8.6 percent for the nation as a whole). Fires ignited by heating systems were implicated in 19.7 percent of Oregon's NFIRS-reported deaths. As in other states, most fires in Oregon were not ignited by standard types of equipment. Slightly less than 40 percent (38.5) of the incidents in Oregon were started by other, less routine equipment categories, such as vehicular ignition, or, even more frequently, by no equipment involvement (34.5 percent of the state's incidents). Such fires led to over one-half (52.5 percent) of Oregon's NFIRS-reported deaths.

The most common *forms of material ignited* in Oregon fires were trees, grass, rubbish, and trash, and other like matter, which collectively represented 39.5 percent of the state's incidents[74] (12.0 percent involving trees and grass and 21.5 percent involving rubbish and trash). Less common but considerably more deadly were fires involving furniture, soft goods, and apparel, which constituted 8.3 percent of the incidents and 37.7 percent of the deaths.

In terms of general incidence, the leading *factor of ignition* in Oregon fires was mechanical failure,[75] which accounted for 25.1 percent of the state NFIRS incidents. Only slightly less frequent (23.9 percent) and substantially more threatening to human life were fires started by the misuse of the heat of ignition. These fires—particularly when abandoned materials or children playing were factors—resulted in a large loss of life—27 (44.3 percent) of the state's NFIRS-recorded deaths.

CASUALTY SUMMARY

Among fire fighters, the risk of casualty has increased moderately in the past several years. In 1982, the number of casualties was 14.9 per 1,000 fires compared 17.6 in 1983. Looking exclusively at casualty incidence in structure fires, the amount increased from 29.0 per 1,000 structure fires in 1982 to 32.9 in 1983.

Among civilians, a similar pattern emerges. In 1982, the level of casualties was 25.1 per 1,000 fires compared to 27.2 in 1983. In terms of structure fires, the number was 49.1 per 1,000 structure fires in 1982 compared to 50.8 in 1983.

TEXAS

Only 17.0 percent of the 1,572 registered fire departments in Texas submitted data to the National Fire Incident Reporting System (NFIRS) during 1983. With such a comparatively low rate of participation, data contained in this analysis most probably are not fully representational of fire activity in Texas. Furthermore, comparisons of Texas data with regional and national figures may be flawed as a result of the small proportion of participation. Readers are cautioned to bear this in mind in the course of their review of this analysis.

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[73]In 4.1 percent of the NFIRS incidents, the equipment involved in ignition was either unknown or unclassified. As a result, findings in this category may not be representational.

[74]In 3.2 percent of Oregon's NFIRS fires, the form of material was either unknown or unclassified. As a result, these findings may not be fully representational.

[75]In 5.7 percent of the incidents, the ignition factor was either unknown or unclassified by NFIRS respondents. As a result findings in this area may not be fully representational.

During 1983, Texas departments reported 66,754 total incidents, 165 fire-related deaths (no fire fighter victims), and 1,537 injuries (including 668 injured fire fighters). Based on NFIRS reports, the largest proportion of Texas incidents (27.9 percent) involved fires in trees, grass, and brushlands. Fortunately, these fires resulted in no known loss of human life. Only slightly less frequent (25.9 percent) and far more dangerous (75.2 percent) were structure fires. Texas respondents reported the incidence of 14,933 vehicle fires, which represented 22.4 percent of the total and were implicated in 23.6 of the NFIRS-reported deaths. Table 8.10 provides a comparative listing of fire situations found in Texas and other Region IV states.

An examination of Texas fire activity by categories of fixed property use reveals that 27.2 percent of the incidents and 75.2 percent of the deaths were the result of residential property fires. Based on NFIRS reports, residential property fires occurred slightly less often than the regional average (28.8 percent). More than half (56.0 percent) of the state's incidents took place in special properties; e.g., outdoor areas, roadways, and other designated locales. Special property fires were implicated in 21.8 percent of the NFIRS-recorded deaths. A complete listing of fire incidence by category of fixed property use in Texas and other Region IV states is provided in Table 8.11.

ELEMENTS OF FIRE INCIDENCE

Further analysis of 1983 fire activity in Texas can be accomplished by using NFIRS data to examine three major causal elements of fire incidence: the equipment involved in a fire's ignition; the form of material first ignited; and the ignition factor. Table Texas-1 summarizes key findings pertaining to this topic and a brief, descriptive overview follows:

TABLE T-1

CAUSAL FACTORS OF TEXAS FIRES

Equipment Involved in Ignition {1}	**Fires**	**Deaths**
—Heating Systems	3.3%	16.4%
—Cooking Equipment	4.6%	1.8%
—Electrical Distribution Equipment	3.8%	3.0%
—Other/No Equipment	67.9%	56.4%
Form of Material Ignited {2}	**Fires**	**Deaths**
—Structural Framework	8.1%	12.1%
—Power Transformation	17.9%	15.2%
—General Form	46.0%	1.8%
—Furniture/Soft Goods/Apparel	7.7%	30.9%
Ignition Factor {3}	**Fires**	**Deaths**
—Misuse of Heat	17.2%	24.2%
—Mechanical Failure	19.5%	10.9%
—Operational Deficiency	5.0%	14.5%
—Arson (Incendiary, Suspicious)	19.6%	9.7%

{Note 1} In 14.9% of all incidents, "Equipment Involved in Ignition" was either unknown or left blank.

{Note 2} In 9.4% of all incidents, "Form of Material Ignited" was either unknown or left blank.

{Note 3} In 27.3% of all incidents, "Ignition Factor" was either unknown or left blank.

As Table Texas-1 indicates, in most Texas fires, standard types of *equipment were not involved in ignition.*[76] More often, other factors, such as vehicular involvement, led to the ignition of Texas fires. Such fires were implicated in 56.4 percent of the recorded deaths. In this category, most frequent were fires started without any equipment involvement (55.2 percent of the state's NFIRS incidents). Analysts speculate that many of these fires were ignited by careless use of lighters, matches, and other smoking materials.

In Texas, as in other states, the *forms of materials most frequently ignited* were trees, grass, rubbish, trash, and other types of general form materials.[77] Fires involving these materials accounted for 46.0 percent of the incidents. Fortunately, such fires are inclined to have a low casualty rate; in Texas, three deaths (1.8 percent) were caused by these fires. Less frequent (7.7 percent) but far more threatening to public safety (30.9 percent of NFIRS deaths) were fires where furniture, soft goods, or apparel were ignited.

Based on NFIRS reports, the principal *ignition factors* in Texas fires were mechanical failure, which contributed to 19.5 percent of the incidents and 10.9 percent of the deaths, and incendiary and suspicious circumstances, which had a 19.6 percent rate of occurrence and were implicated in 9.7 percent of the deaths.[78] Fires involving the misuse of heat of ignition—particularly when associated with abandoned materials, children playing, or open fire—took place a little less often (17.2 percent) but were implicated in a higher proportion of deaths (24.2 percent).

CASUALTY SUMMARY

Based on NFIRS reports, the risk of casualty from Texas fires remained relatively stable in the past several years. For fire fighters, the general level of risk increased from 8.3 casualties per 1,000 fires in 1982 to 10.0 in 1983. Looking only at structure fires, the number of casualties among fire fighters declined from 39.5 per 1,000 structure fires in 1982 to 38.7 in 1983.

For civilians, the general number of casualties rose from 12.7 per 1,000 fires in 1982 to 15.5 in 1983. In terms of structure fires, the number increased from 60.5 casualties per 1,000 structure fires in 1982 to 59.9 in 1983.

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[76]In 14.9 percent of the incidents and 19.4 percent of the deaths, the equipment involved in ignition was either unknown or unclassified by Texas NFIRS respondents. As a result, findings contained in this section may not be fully representational.

[77]In 9.4 percent of the incidents and 20.6 percent of the deaths, the form of material ignited was either unknown or unclassified by Texas NFIRS respondents. Because of this the findings contained in this section may not be fully representational.

[78]In 27.3 percent of the fires and 29.1 percent of the deaths, the ignition factor was either unknown or unclassified by Texas NFIRS respondents. As a result, findings pertaining to this topic may not be fully representational.

UTAH

Slightly more than one-third (31.3 percent) of the 360 registered fire departments in Utah submitted data to the National Fire Incident Reporting System (NFIRS) in 1983. During the year, Utah respondents reported a total of 6,880 incidents, 23 fire-related deaths (none among fire fighters), and 136 injuries (69 among fire fighters).

According to NFIRS reports, the most common fire situation in Utah involved trees, brush, and grasslands. In 1983, 34.0 percent of the Utah fires reported fell in this category. No deaths were reported from such fires. In turn, structure fires, which constituted 28.5 percent of the incidents, were implicated in a high proportion of deaths (69.6 percent). A complete listing of fire situations in Utah and other states in Region IV is provided in Table 8.10.

An examination of fire incidence by categories of fixed property use indicates that Utah fires, as in most states, most often take place on special properties; e.g., outdoor areas, roadways, construction sites, abandoned property, and other such locales.[79] In 1983, 45.4 percent of the NFIRS incidents occurred on special properties, principally outdoor areas and roadways; these fires were directly responsible for 26.1 percent of the NFIRS-recorded deaths. More dangerous with respect to public safety were residential property fires, which accounted for 26.0 percent of the incidents and 43.4 percent of the deaths. A comparative listing of Utah's fire experience, by fixed property use category, and those of other Region IV states is presented in Table 8.11.

ELEMENTS OF FIRE INCIDENCE

Further analysis of Utah fire activity can be achieved by using NFIRS data to examine three major causal elements of fire incidence: the equipment involved in a fire's ignition; the form of material first ignited; and the ignition factor. A summary of these data findings is presented in Table Utah-1 and is followed by a brief descriptive overview.

[79]In 14.1 percent of the incidents, the category of fixed property use was not classified by Utah NFIRS respondents. As a result, data findings pertaining to this topic may not be fully representational.

TABLE U-1

CAUSAL FACTORS IN UTAH FIRES

Equipment Involved in Ignition {1}	**Fires**	**Deaths**
—Heating Systems	5.3%	0.0
—Cooking Equipment	3.7%	8.7%
—Electrical Distribution Equipment	3.7%	0.0
—Other/No Equipment	65.2%	65.2%

Form of Material Ignited {2}	**Fires**	**Deaths**
—Structural Framework	8.7%	0.0
—Power Transformation	20.1%	17.4%
—General Form	51.9%	0.0
—Furniture/Soft Goods/Apparel	6.5%	13.0%

Ignition Factor {3}	**Fires**	**Deaths**
—Misuse of Heat	25.7%	39.1%
—Mechanical Failure	21.9%	4.3%
—Operational Deficiency	6.1%	17.4%
—Arson (Incendiary, Suspicious)	10.7%	4.3%

{Note 1} In 15.9% of all incidents, "Equipment Involved in Ignition" was either unknown or left blank.

{Note 2} In 5.9% of all incidents, "Form of Material Ignited" was either unknown or left blank.

{Note 3} In 18.4% of all incidents, "Ignition Factor" was either unknown or left blank.

In most Utah fires, as in other states, routine categories of *equipment frequently were not involved in ignition.*[80] More commonly, other factors were at hand in fire incidence (65.2 percent). In 1983, 65.2 percent of the NFIRS deaths were the result of such fires. Moreover, 59.7 percent of these fires were ignited by no equipment whatsoever. In many of these instances, analysts speculate, fires resulted from the careless use of matches, lighters, and other similar materials.

In Utah, the principal *form of material ignited* involved the ignition of general form materials (51.9 percent of incidence), particularly trees and grass.[81] Another leading form in Utah fires was power transformation equipment or fuel, which contributed to 20.1 percent of the incidents and 17.4 percent of the deaths.

[80]In 15.9 percent of the incidents, the equipment involved in ignition was either unknown or unclassified by Utah NFIRS respondents. Because of this, data findings contained in this section may not be fully representational.

[81]In 5.9 percent of the incidents and 17.4 percent of the deaths, the form of material ignited was either unknown or unclassified by Utah NFIRS respondents. Because of this, some of the content in this section may not be fully representational of the state's fire record.

In terms of both incidence and deaths, the most critical *factor of ignition* in Utah fires was misuse of heat of ignition, particularly in fires involving children playing, abandoned materials, and open fires.[82] In 1983, these fires, which represented 25.7 percent of the NFIRS reports, were implicated in 39.1 percent of the deaths. Based on NFIRS reports, arson-related factors were considerably less prominent in Utah fires (10.7 percent of total incidents and 4.3 percent of deaths) when compared to averages for the region (21.5 percent and 20.2 percent respectively) and the nation (17.3 percent and 13.9 percent).

CASUALTY SUMMARY

The likelihood of casualty from fires in Utah has increased slightly in the past few years. In 1982, the number of casualties among fire fighters was 9.1 per 1,000 fires compared to 10.0 in 1983. In terms of structure fires, the amount for fire fighters increased from 31.0 to 35.1 per 1,000 structure fires in 1983.

For civilians, the general level of risk rose from 26.0 casualties per 1,000 fires in 1982 compared to 27.9 in 1983. Looking solely at structure fires, the number of casualties involving civilians increased from 88.5 in 1982 to 97.8 per 1,000 structure fires in 1983.

WASHINGTON

In 1983, close to one-quarter of the 800 fire departments in the state of Washington submitted data to the National Fire Incident Reporting System (NFIRS). During this period, participating departments recorded 23,079 total incidents, 39 deaths (none among fire fighters), and 628 injuries (247 suffered by fire fighters). A little less than half (48.6 percent) of these incidents were structure fires. Such fires resulted in 66.7 percent of the state's NFIRS reported deaths. The occurrence of structure incidents was considerably more frequent than averages for the region (30.3 percent) and the nation (35.8 percent). Fortunately, the proportion of deaths arising from such fires was only slightly higher than the regional average (63.2 percent) and much less than that of the nation (77.6 percent). A complete list of fire situations found in Washington and other Region IV states is provided in Table 8.10.

An examination of fire incidence by categories of fixed property use indicates that fires most commonly took place in residential property. In 1983, 46.5 percent of Washington's NFIRS-reported fires and 69.2 percent of its fire-related deaths were attributable to residential incidents. Washington's rate of residential fire incidence was considerably higher than regional (28.8 percent) and national (30.3 percent) averages. A complete listing of fire incidence by fixed property use in Washington and other Region IV states is presented in Table 8.11.

ELEMENTS OF FIRE INCIDENCE

Additional analysis of Washington fire activity can be accomplished by using NFIRS data to examine three major causal elements of fire incidence: the equipment involved in a fire's ignition; the form of material first ignited; and the ignition factor. A summary of the findings pertaining to these elements is presented in Table Washington-1 and is followed by a brief descriptive overview.

[82]In 18.4 percent of the incidents and 13.0 percent of the deaths, the ignition factor was either not known or not identified by NFIRS respondents in Utah. As a result, findings on this topic may not be fully representational.

TABLE W-1

CAUSAL FACTORS IN WASHINGTON FIRES

Equipment Involved in Ignition {1}	**Fires**	**Deaths**
—Heating Systems	23.2%	10.3%
—Cooking Equipment	5.8%	2.6%
—Electrical Distribution Equipment	5.6%	7.7%
—Other/No Equipment	51.1%	69.2%
Form of Material Ignited {2}	**Fires**	**Deaths**
—Structural Framework	9.6%	2.6%
—Power Transformation	30.4%	20.5%
—General Form	32.4%	5.1%
—Furniture/Soft Goods/Apparel	7.7%	38.5%
—Special Form	3.9%	7.7%
Ignition Factor {3}	**Fires**	**Deaths**
—Misuse of Heat	18.3%	38.5%
—Mechanical Failure	23.3%	20.5%
—Operational Deficiency	9.3%	20.5%
—Arson (Incendiary, Suspicious)	12.3%	7.7%
—Misuse of Material	19.7%	10.3%

{Note 1} In 6.9% of all incidents, "Equipment Involved in Ignition" was either unknown or left blank.

{Note 2} In 4.4% of all incidents "Form of Material Ignited" was either unknown or left blank.

{Note 3} In 10.0% of all incidents, "Ignition Factor" was either unknown or left blank.

As is the case in states with cooler climates, Washington had a comparatively high incidence of fires which started from heating *equipment involved in ignition.* Over one-fifth (23.2 percent) of the state incidents reported in NFIRS were caused by heating systems.[83] Four of Washington's 39 fire deaths resulted from these fires. The proportion of heating system fires was considerably higher than both regional (6.7 percent) and national (8.6 percent) averages. Fortunately, the percentage of deaths resulting from these fires was no worse than the regional average and, in fact, was slightly less than that of the nation (11.1 percent).

More than half (51.1 percent) of the fires in Washington started as a result of other factors beyond the standard categories of equipment. Such fires were ignited by vehicular equipment involvement and other causal conditions. Many of these fires were started without any equipment involvement. Analysts speculate that such fires often are ignited through the careless use of matches, lighters, and other smoking materials.

[83]In 6.9 percent of the incidents, the equipment involved in ignition was either unknown or unclassified by Washington NFIRS respondents. As a result, data findings contained in this section may not be fully representational.

As in other states, the principal *forms of material ignited* were trees, grass, rubbish, trash, and other general form matter. In Washington fires, these materials were involved in 32.4 percent of the incidents.[84] Less frequent (7.7 percent of the total) but far more threatening to human life (38.5 percent of the NFIRS deaths) were fires where furniture, soft goods, and apparel were ignited.

The leading *ignition factor* in Washington fires was mechanical failure, which was implicated in the start of 23.3 percent of the NFIRS incidents.[85] Fires which began as a result of misuse of heat of ignition (18.3 percent of the total) had a substantially higher incidence of death (38.5 percent).

CASUALTY SUMMARY

In 1983, the general level of risk for fire fighters was 10.7 casualties per 1,000 fires. Looking only at structure fires, the number was higher—22.0 per 1,000 structure fires. For civilians, the general amount of casualties was 18.2 per 1,000 fires and, from structure fires, 37.4 casualties per 1,000 fires. No comparative data on casualty incidence in 1982 or prior years in Washington was available.

WYOMING

In 1983, only 40 of Wyoming's 132 registered fire departments submitted data to the National Fire Incident Reporting System (NFIRS). However, NFIRS data reports generally were thoroughly completed by Wyoming respondents with a comparatively low incidence of unknown or unclassified data entries. This attention to detail assists in making the data more fully representational of Wyoming's true fire record. The efforts of the Wyoming fire departments help to strengthen and refine our regional and national fire data base. The U.S. Fire Administration appreciates the commitment of these departments.

During the year, Wyoming departments reported a total of 2,360 incidents, five deaths (none among fire fighters), and 44 injuries (including 19 fire fighter victims).

In terms of fire situations found, Wyoming's experience was roughly comparable to the national pattern. As in the national average, a little over 35 percent (36.6) of the state's fire situations were structure incidents. All five of the deaths reported to NFIRS in 1983 resulted from structure fires. Wyoming departments reported a smaller proportion of fires involving vehicles (19.2 percent) than is reflected in the national average (24.6 percent) and a larger incidence of fires in trees, brush, and grasslands (26.9 percent compared to 19.9 percent nationally). A complete listing of fire situations in Wyoming and other states in Region IV is provided in Table 8.10.

A look at Wyoming's fire record by categories of fixed property use (See Table 8.11) reveals that the largest proportion (44.8 percent) of the state's fires took place in special properties—particularly on roadways and in outdoor areas. This is generally in keeping with the national average (46.9 percent) and slightly down from the regional proportion

[84]In 4.4 percent of the incidents, the form of material ignited was either unknown or unclassified by Washington NFIRS respondents. Because of this, some of the content in this section may not be fully representational of the state's fire record.

[85]In 10.0 percent of the fires and 2.6 percent of the deaths, the ignition factor was either not known or not identified by Washington NFIRS respondents. Because of this, the findings contained in this section may not be fully representational.

(54.7 percent). In terms of loss of life, Wyoming's residential fires posed the most critical problem for the state. Four of the five deaths reported stemmed from residential fires.

ELEMENTS OF FIRE INCIDENCE

A more detailed analysis of fire activity in Wyoming can be undertaken by using NFIRS data to examine three major elements of fire incidence: the equipment involved in a fire's ignition; the form of material first ignited; and the ignition factor. Table Wyoming-1 provides a breakdown of these findings and is followed by a brief, descriptive overview.

TABLE W-1

CAUSAL FACTORS OF WYOMING FIRES

Equipment Involved in Ignition {1}	**Fires**	**Deaths**
—Heating Systems	13.7%	20.0%
—Cooking Equipment	3.6%	0.0
—Electrical Distribution Equipment	4.0%	0.0
—Other/No Equipment	64.3%	80.0%
Form of Material Ignited {2}	**Fires**	**Deaths**
—Structural Framework	11.1%	20.0%
—Power Transformation	19.7%	40.0%
—General Form	51.1%	0.0
—Furniture/Soft Goods/Apparel	6.6%	20.0%
Ignition Factor {3}	**Fires**	**Deaths**
—Misuse of Heat	24.0%	20.0%
—Mechanical Failure	30.5%	0.0
—Operational Deficiency	7.1%	40.0%
—Arson (Incendiary, Suspicious)	5.0%	20.0%
—Misuse of Material Ignited	7.0%	0.0

{Note 1} In 6.4% of all incidents, "Equipment Involved in Ignition" was either unknown or left blank.

{Note 2} In 3.4% of all incidents, "Form of Material Ignited" was either unknown or left blank.

{Note 3} In 14.1% of all incidents, "Ignition Factor" was either unknown or left blank.

In 64.3 percent of the Wyoming NFIRS incidents, other factors or no *equipment was involved in ignition.*[86] With regard to the latter instance, analysts speculate that "equipment-less" fires often are ignited by the careless use of matches, lighters, and other smoking materials. In fires where equipment was a source of ignition, heating systems had the highest proportion (13.7 percent) of involvement. Within this category, fireplace incidents (5.0 percent of all NFIRS fires) were particularly prevalent.

[86]In 6.4 percent of the incidents, the equipment involved in ignition was either not known or not classified by Wyoming NFIRS respondents. As a result, the findings contained in this section may not be fully representational.

Just over one-half (51.1 percent) of the Wyoming fires occurred when general *form materials ignited.*[87] Fires involving trees and grass (25.7 percent) as well as rubbish and trash (21.0 percent). Fortunately, these fires did not result in any known loss of human life. In turn, fires where power transformation equipment or fuel ignited, which represented 19.7 percent of the state incidents, were implicated in two deaths.

In terms of general incidence, the principal *ignition factor* in Wyoming fires was mechanical failure, which was involved in 30.5 percent of the NFIRS-reported fires.[88] Second ranking in incidence were fires started by the misuse of heat of ignition, which represented 24.0 percent of the fires. Two deaths resulted from fires involving operational deficiencies, which caused the ignition of 7.0 percent of the NFIRS incidents.

CASUALTY SUMMARY

The risk of casualties from Wyoming fires generally increased in the past several years. General risk among fire fighters rose from 6.7 per 1,000 fires in 1982 to 8.1 in 1983. In terms of fire fighting risks from structure fires, the number of casualties increased from 18.0 per 1,000 structure fires to 34.7 in 1983.

Looking at civilian casualties, the general level of risk remained stable—12.2 per 1,000 fires in 1982 compared to 12.7 in 1983. In terms of structure fires, there was a slight increase in casualty incidence. The number rose from 32.8 per 1,000 structure fires in 1982 to 34.7 in 1983.

[87]In 3.4 percent of the incidents, the form of materials ignited was either not known or not classified by Wyoming NFIRS respondents. As a result, the findings contained in this section may not be fully representational.

[88]In 14.1 percent of the incidents and 20.0 percent of the deaths, the ignition factor was either not known or not classified by Wyoming NFIRS respondents. As a result, the findings contained in this section may not be fully representational.

chapter 9

appendices

APPENDIX A

GLOSSARY OF TERMS

GLOSSARY

absolute analysis — See *absolute measures.*

absolute measures — Within the context of this report, *absolute measures* are numbers used to measure the *importance* of the fire problem. These measures also enable analysts to compare the overall size of one aspect of the fire problem with another. Four forms of absolute measurement have been used throughout this report: the number of fires; the number of fire-related deaths; the number of fire-related injuries; and the amount of property loss.

alternative heaters — Heaters that are used to supplement or supplant central heating units.

apartments, tenements, and flats — The National Fire Incident Reporting System defines this category of residential occupancy as multi-family quarters with individual kitchen units for individuals and families living independently of one another.

area of fire origin — Every fire has an area of origin. This term is defined in the NFIRS Handbook as the primary use of the area where a given fire originated in a particular property. *The area of origin may be a room, an area or portion of a room, a vehicle or a portion of a vehicle or possibly some open area devoted to a specific use.*

arson — In the context of *Fire in the United States*, this term includes all fires ignited through either incendiary or suspicious circumstances. In *Fire Terms: A Guide to Their Meaning and Use*, *arson* is defined as the *crime of willfully burning a dwelling, building, structure, or other property including ones own.*

boarding houses — See *rooming, boarding, and lodging houses.*

cabinet heaters — This term refers to portable heaters housing a 20 pound rechargeable propane cylinder.

casualty — See *fire fighter casualty* and *civilian casualty.*

cause — See *fire cause.*

civilian — In the context of this report, *civilian* refers to any individual who is not a member of the fire service.

civilian casualty — This term refers to any civilian's physical injury or death associated with a fire incident to which a fire department responded, excluding Emergency Medical Service runs. To be recorded in the National Incident Reporting System, an injury must be of a level of severity to require treatment by a medical practitioner (regardless whether or not the treatment was received) within one year of the incident.

direct cause of loss — A characteristic used in both scenario analysis and single factor analysis to describe the reasons for damage or destruction —e.g., smoke, gas, heat, and flame —in a particular fire incident.

dormitories — In the National Fire Incident Reporting System Handbook, this term refers to long-term living quarters provided to occupants who are not members of the same family group and who are housed individually in either one room or a series of closely associated rooms.

educational properties — In the NFIRS Handbook, *educational property* is defined as *those used for purposes of instruction such as schools, colleges, universities, and academies.* Educational properties are distinct from public assembly properties in that individuals who congregate in educational properties meet there regularly and are generally submitted to some measures of discipline and control.

EMS — This term refers to emergency medical service.

envelope houses — Designed and constructed for energy efficiency, these houses are positioned partially underground. They are ultra-tight, super-insulated units.

equipment involved in ignition — In the National Fire Incident Reporting System Handbook, this is defined as the *piece of equipment, if any, which provided the principal heat that caused ignition, whether the equipment malfunctioned or was used improperly.*

fire — In the general context of this report, *fire* refers to the chemical principle resulting in hostile and uncontrolled combustion.

fire causal elements — in the context of *Fire in the United States*, *fire cause* is a shorthand notation for what is sometimes a complex chain of events leading to a fire.

fire fighter casualty — This term refers to any fire fighter injury or death.

fire loss — See *direct property loss.*

fire origin — See *area of fire origin.*

fire problem — In *Fire in the United States*, *fire problem* refers to the loss of property, health, safety, and lives that results from destructive fires.

Fire Department Identification Number (FDID) — A state-assigned number which is used to identify a particular fire department in a given state. Known as an *FDID*, this number may also be used as a means for identification of the county, fire district, or other jurisdiction where a fire department is located.

fixed local heaters — This term refers to fixed heating systems, such as wood stoves, chimneys, stationary electric units, or fireplaces, which supplant or supplement central heating units.

fixed property use — Every property has a particular use whether it is a residential structure or an undeveloped stretch of land. In the National Fire Incident Reporting System Handbook, *fixed property use* is defined as the use of the particular property where a specific fire occurs. For example, if a fire occurs in a property which the owner calls a *hotel* but which is used as an apartment, the fire would be categorized by NFIRS

respondents by its actual fixed property use definition, e.g., apartment. This method of classification provides analysts a means of studying the fire problem by property use.

fire service — This term refers to the fire fighting profession as a whole.

flash-over — This term refers to a phenomenon which occurs when a fire grows and heat builds until a point is reached where all combustible material reach their ignition temperature and begin burning simultaneously.

flats — See *apartments, tenements, and flats.*

form of heat of ignition — In the National Fire Incident Reporting System Handbook, this term is defined as the heat energy form which starts any given fire; e.g., an open flame, a hot surface, an arc, or a spark. It is emphasized in the NFIRS Handbook that *every fire has a form of heat of ignition.*

glued-wood trusses — Commonly used in new construction in place of wooden or metal supports. These trusses —composed of small fragments of wood which are glued together between two or more larger pieces —are used as a means of reducing construction costs.

home hotels — In NFIRS, this form of residential occupancy is classified as living quarters for individuals or families living independently and on a transient basis. Unlike other types of transient residences, home hotels have individual kitchens in each unit.

hotels, motels, inns, and lodges — In the National Fire Incident Reporting System Handbook, these residential occupancies are defined as short-term living quarters where there are sleeping accommodations the capacity to house more than fifteen persons.

ignition factor — The NFPA defines *ignition* as the *point at which the heating of something becomes self perpetuating.* In this context, an *ignition factor* is an identifiable circumstance influencing or contributing to a fire's ignition.

ignition source — This term refers to equipment flame or spark that enables ignition to take place.

incendiary — A fire that is generally considered to have been set deliberately is an *incendiary* incident.

inns — See *hotels, motels, inns, and lodges.*

lodges — See *hotels, motels, inns, and lodges.*

lodging houses — See *rooming, boarding, lodging houses.*

manufacturing property — In the NFIRS handbook, *manufacturing property* is defined to include all properties where *there is mechanical or chemical transformation of inorganic or organic substances into new products.* Properties used for this purpose are included regardless of whether the work is accomplished by hand or by machine, in a home or in a factory, and whether the product is sold at wholesale or retail prices.

material ignited — See *type of material ignited* and *form of material ignited.*

mobile property use — This term, as defined in NFIRS, provides a means of classifying property which was *designed to be movable, either under its own power or towed, whether*

in fact it is still movable. Included in this category are vehicles used for passenger road transport, freight road transport, air transport, and heavy equipment. Other special vehicles, such as garden equipment vehicles, are also included in this category as are several miscellaneous types of mobile property. This method of classification enables analysts to study the fire problem by mobile property use.

motels — See *hotels, motels, inns, and lodges.*

occupancy — *Occupancy* is defined as the *use or intended use of a building, floor, or other part of a building* in *Fire Terms: A Guide to Their Meaning and Use* by Ralph W. Purklin and Robert G. Purington (NFPA: Boston, 1980).

office property — See *store and office property.*

one- and two-family dwellings — As used in NFIRS, these terms refer to occupancies used both seasonally and year-round, row houses separated by fire division walls, and fixed mobile homes used for residential purposes.

portable local heaters — Known as space heaters, these units are used to supplement or supplant existing control or fixed heating systems. They usually are kerosene, gas or electrically powered.

public assembly property — Based on the NFIRS definition, *public assembly property* includes all places where people voluntarily gather for social, recreational, civic, religious, and other similar purposes. Typically, these properties are the sites, or potential sites, for large crowds of individuals who have temporarily assembled on the premises and who do not intend to sleep on the property.

ranking strips — In this edition of *Fire in the United States,* ranking strips are tables that describe elements of fire problems by using absolute and relative measures. Ranking strips are designed to present comparative fire data in order to provide readers a quick frame of reference about the fire problem.

relative analysis — See *relative measures.*

relative measures — A *measurement* is a determination of the extent or quantity of an element of the fire problem. *Relative* measures enable analysts to compare various components of the fire problem one another. Unlike absolute measures, *relative* numbers enable analysts to measure *relative* risks of fire-related problems.

residential property — Defined by the National Fire Incident Reporting System as that where *sleeping accommodations are provided for normal living purposes.* Included in this classification are one and two-family dwellings; apartments, tenements, and flats; rooming, boarding, and lodging houses; hotels, motels, inns, and lodges; dormitories; home hotels; and a miscellaneous category, which includes children's playhouses, outdoor sleeping quarters, and other areas). Institutional residences are excluded from this NFIRS category.

rooming, boarding, and lodging houses — As defined in NFIRS, these terms refer to residences of either short-term or long term, separate living quarters, no kitchens in units. Rooming house provide rooms but no meals, boarding houses provide rooms and meals. Residential care facilities provide room, board, and minimal care. {Note: *Lodging houses* should not be confused *lodges;* see *hotels, motels, inns, and lodges* for further clarification.}

scenario analysis — In this method of study, analysts isolate and examine the chain of factors that influences or contributes to a particular fire. A *scenario* is an abbreviated, short-hand description of a fire. Characteristics commonly used in the development of scenarios by analysts at the U.S. Fire Administration are type of loss; type of occupancy; time of incident; ignition source; item ignited; and direct cause of loss.

single factor analysis — Broadly speaking, *analysis* can be defined as a separation or conversion of the fire problem into simpler elements for study. In *single factor analysis*, unique elements of the fire problem are isolated and studied separately.

solid fuel heaters — This term refers to heaters that use wood, coal, or coke rather than kerosene, gas, or electricity. Common examples are wood stoves and fireplaces.

special property — As used in the NFIRS handbook, this term refers to all properties that do not fall in other major NFIRS categories of fixed property use. Included in this classification are properties under demolition or construction; outdoor properties; waterways; railroad, aircraft, road, and parking properties; equipment operating areas; certain special structures (bridges, tunnels, telephone booths, and other such properties); and miscellaneous unclassified special properties or fixed property uses.

storage property — Based on the NFIRS definition, this term includes *all buildings, structures or areas utilized primarily for the storage or sheltering of goods, merchandise, products, vehicles, or animals; and incidental servicing, processing, and repair operations.* Storage properties are inclined to have a relatively small number of persons in proportion to the area.

store and office property — In the NFIRS handbook, store properties are defined to include *all markets and other areas, buildings, or structures for the display, sale repair, or service of merchandise, new or used, purchased or rented.* Office properties refer to *those which are principally used for the transaction of business and the keeping of private or public records.*

structure fire — In the book, *Fire Terms: A Guide to Their Meaning and Use*, *structure fire* is defined as any *fire inside, on, under, or touching a structure.* In turn, *structure* is defined as an *assembly of materials constructed to serve a specific purpose.*

suspicious fires — See *arson fires.*

tenements — See *apartments, flats, and tenements.*

type of material ignited — This term, used in NFIRS, refers to the composition of material initially ignited by a heat source in any given fire incident.

wildfires — Fires that occur on unimproved lands, wild lands, or watershed.

APPENDIX B

1983 FIRE FIGHTER LINE-OF-DUTY DEATHS

State	*City*	*Type of Duty*	*Fireground Operation*	*Cause of Death*	*Age*
ALABAMA					
1/5/83	Ozark	Operating at a fire	Stretching a hose line		58
ARIZONA					
5/12/83	Parker	Attempting a water rescue in an irrigation ditch		Drowning	51
CALIFORNIA					
2/10/83	Los Angeles	Participating in physical fitness		Heart	53
2/24/83	Orange	Responding		Head trauma as a result of falling from jump seat of moving fire apparatus	56
4/8/83	Fullerton	Responding		Multiple trauma as a result of being thrown from apparatus	48
5/20/83	Rocklin	Operating at a fire	Hauling equipment up steep hill to structure fire	Heart	39
8/27/83	Pasadena	Responding		Head trauma trauma resulting from a fall from the back step of apparatus	23
11/19/83	Sacramento	Fire prevention and inspection duties		Trauma resulting from being struck by vehicle	44
12/14/83	Los Angeles	In charge of a crew of inmates assisting county road department		Electrocution	45
COLORADO					
3/25/83	Parker	Assisting at a medical emergency		Heart	59
CONNECTICUT					
3/21/83	Bridgeport	Operating at a fire	Loading hose on apparatus	Heart	53
4/15/83	Uncasville	Responding		Heart	42
5/23/83	East Hartford	Fire station administrative duties		Heart	55

State	City	Type of Duty	Fireground Operation	Cause of Death	Age
FLORIDA					
3/4/83	Pensacola	Operating at a fire	Advancing hose line	Heart	42
3/4/83	Pensacola	Operating at a fire	Advancing hose line	Heart	53
5/6/83	Tampa	Operating at a fire		Heart	49
7/7/83	Pensacola	Driving fire apparatus between fire stations (non emergency)		Multiple trauma after being thrown from cab of apparatus	23
10/24/83	Miami	Fire station duties		Heart	37
12/9/83	Clearwater	Fire station duty		Heart	48
GEORGIA					
9/21/83	Decatur	Providing medical aid assistance		Gunshot wound	52
ILLINOIS					
1/7/83	Wolf Lake	Operating at a fire	Manning a hose line	Multiple trauma	52
1/15/83	Murphysboro	Operating at a fire	Directing snorkle apparatus operation	Heart following	46
1/17/83	Hamel	Participating in company drill		Heart	48
1/21/83	New Lenox	Responding		Multiple trauma resulting from an apparatus accident	19
1/23/83	Peoria	Operating at a fire	Manning a hose line	Multiple trauma resulting from wall collapse	38
8/8/83	Tolono	Operating at a fire	Attempting to rescue occupants from a structure fire	Smoke inhalation	44
8/9/83	Chicago	Operating a fire	Searching dwelling for children reportedly trapped	Smoke inhalation	33
12/1/83	Fairmont	Operating at a fire	Performing apparatus maintenance on stalled pumper	Heart	45
12/28/83	Danville	Operating at a fire	Directing fire fighting operations	Heart	59
KANSAS					
7/15/83	Claflin	Operating at a fire	Extinguishing a grass fire	Heart	49
KENTUCKY					
1/18/83	Springfield	Operating at a fire	Directing fireground operations	Heart	54
3/5/83	Winchester	Operating at a fire	Pilot of B-26 air tanker dropping retardant on forest fire	Head trauma resulting from tanker crash	38
10/12/83	Barbourville	Operating at a fire	Directing fire fighting operations at a structure fire	Heart	76

State	City	Type of Duty	Fireground Operation	Cause of Death	Age
LOUISIANA					
1/28/83	Houma	Operating at a fire	Directing fireground operations	Heart	50
MARYLAND					
7/16/83	Ocean City	Operating at a fire	Assisting interior fire suppression at a structure fire	Smoke inhalation	24
9/12/83	Morningside	Responding		Multiple trauma resulting from being run over by apparatus	24
MASSACHUSETTS					
1/15/83	Newton	Responding		Heart	56
3/9/83	Springfield	Responding		Heart	61
3/26/83	Beverly	Operating at a fire	Advancing a hose line at the scene of a woods fire	Heart	56
10/12/83	Braintree	Fire station duties		Heart	58
11/4/83	Boston	Fire station duties		Head trauma resulting from a fall while on duty at the fire station	29
12/4/83	Southbridge	Assisting on an ambulance call		Heart	49
MICHIGAN					
2/20/83	Sterling	Responding		Head trauma as a result of falling from jump seat of moving fire apparatus	38
4/17/83	Livonia	Operating at a fire	Operating inside a structure fire	Multiple trauma resulting from being trapped beneath a roof collapse	34
10/26/83	Dearborn	Fire marshal court duty		Heart	43
MINNESOTA					
12/23/83	Lyle	Operating at a fire	Extinguishing a chimney fire	Heart	59
MISSOURI					
3/1/83	Creighton	Operating at a fire	Outside of structure after assisting interior fire fighting	Heart	46
3/24/83	Riverview	Operating at a fire	Checking furnace in basement of structure	Heart	55
8/12/83	Chillicothe	Fire station duties		Heart	49
MONTANA					
12/6/83	Anaconda	Operating at a fire	Performing apparatus maintenance on stalled pumper	Heart	45
NEBRASKA					
4/19/83	Omaha	EMS Call		Heart	52

State	City	Type of Duty	Fireground Operation	Cause of Death	Age
NEVADA					
8/27/83	Carson City	Operating at a fire	Backfiring along a road at a forest fire subjected to a sudden wind change	Burns	27
NEW JERSEY					
1/13/83	Branchville	Operating at a fire	Setting up road flares	Drowning	40
1/17/83	New Milford	Operating at a fire	Manning hose line on interior of fire building	Smoke inhalation	22
3/15/83	Heightstown	Operating at a fire	Directing Traffic	Heart	79
4/13/83	East Orange	Operating at a fire	Searching for occupants reportedly trapped in an apartment building fire	Cardiac arrest due to 80% body burns	37
7/21/83	Hammontown	Operating at a fire	Extinguishing a fire at a fruit farm when an irrigation pump exploded	Burns	25
9/9/83	Maplewood	Operating a fire		Heart	40
12/13/83	Wayne	Returning from a residential fire call; Fire fighters were using a boat due to flooding conditions		Drowned after boat turned over	25
NEW MEXICO					
9/25/83	Nara Vista	Operating at a fire	Fighting a grass fire	Electrocution resulting from being struck by lightning	20
12/18/83	Los Alamos	Operating at a rescue call		Internal injuries resulting from a fall from a cliff	41
NEW YORK					
1/23/86	Avon	Operating at a fire	Advancing hose line to interior of structure	Smoke inhalation	24
3/2/83	Utica	Operating at a fire	Using fire broom to extinguish a grass fire	Heart	51
4/10/83	Yonkers	Operating at a fire	Searching for occupants trapped in an apartment house fire	Smoke inhalation	41
4/18/83	Tully	Assisting at a medical emergency		Heart	58
5/12/83	Watertown	Operating at a motor vehicle accident	Assisting in the removal of a trapped victim	Heart	59
5/20/83	Cherry Creek	Operating at an automobile fire		Heart	55
6/6/83	Fort Edward	Dispatcher duties		Heart	62
6/27/83	Riverhead	Operating at a fire	Directing fire fighting operations at an automobile fire	Heart	42
8/20/83	New York	Responding to a false alarm		Heart	45
9/26/83	Buffalo	Operating at a hazardous condition	Removing a leaking refrigerator from an apartment building	Heart	54

State	City	Type of Duty	Fireground Operation	Cause of Death	Age
10/8/83	New Rochelle	Assisting at a medical emergency		Stroke	47
11/5/83	Newton Falls	Operating at a fire	Operating a portable extinguisher	Burns resulting from a boiler explosion	22
12/27/83	Buffalo	Operating at a fire		Multiple trauma resulting from a propane explosion	43
12/27/83	Buffalo	Operating at a fire		Multiple trauma resulting from a propane explosion	37
12/27/83	Buffalo	Operating at a fire		Multiple trauma resulting from a propane explosion	39
12/27/83	Buffalo	Operating at a fire		Multiple trauma resulting from a propane explosion	36
12/27/83	Buffalo	Operating at a fire		Multiple trauma resulting from a propane explosion	47
NORTH CAROLINA					
5/3/83	Hope Mills	Operating at a fire	Working at a woods fire	Heart	52
5/24/83	Winston Salem	Assisting a river search for drowning victim		Drowning	24
OHIO					
3/3/83	Medina	Operating at a fire	Extinguishing a grass fire	Heart	55
4/8/83	Holland	Operating at a fire	Extinguishing a leaves fire	Heart	53
4/26/83	Findlay	Operating at a fire	Operating a hose line from the exterior of a structure fire	Heart	36
12/9/83	Put-In-Bay	Responding to medical aid, on Kelly's Island, Lake Erie		Hypothermia and drowning	21
12/9/83	Put-In-Bay	Responding to medical aid, on Kelly's Island, Lake Erie		Hypothermia and drowning	37
12/9/83	Put-In-Bay	Responding to medical aid, on Kelly's Island, Lake Erie		Hypothermia and drowning	47
12/24/83	New Bloomington	Filling water tank on apparatus after returning from a fire		Head trauma resulting from fall from apparatus	44
OKLAHOMA					
2/9/83	Brestow	Operating at a fire	Directing fireground operations	Head trauma as a result of a wall collapse	39

State	City	Type of Duty	Fireground Operation	Cause of Death	Age
PENNSYLVANIA					
2/7/83	Muir	Operating at a fire	Operating pumper controls	Heart	66
2/11/83	Allentown	Operating at a fire	Manning a hose line	Heart	55
2/13/83	Lebanon	Collapsed after fighting a residential fire		Heart	49
2/27/83	Johnstown	Responding		Heart	58
3/1/83	Huntingdon	Responding		Heart	43
3/29/83	Tyrone	Responding		Heart	73
8/9/83	Codorus	Operating at the scene of an electrical accident	Taking down a 40 foot aluminum ladder	Electrocution	25
8/11/83	Vandergrift	Not emergency duty related		Massive blunt trauma after being thrown from back step of apparatus after apparatus skidded on rain slicked highway	18
10/5/83	Silverdale	Participating in fire company drill		Heart	37
12/28/83	Pittsburgh	Responding		Multiple trauma resulting from motor vehicle accident	47
RHODE ISLAND					
10/2/83	Warwick	Operating at a vehicle	Attempting to search vehicle for occupants	Electrocution resulting from contact 7200 volt electrical line	27
TENNESSEE					
3/24/83	Crossville	Participating in fire company drill	Completed burning abandoned building	Heart	36
TEXAS					
1/4/83	Houston	Responding		Multiple trauma as a result of a motor vehicle accident	53
1/8/83	Waxahachie	Operating at a fire	Manning a hose line	Multiple trauma resulting from a wall collapse	34
VIRGINIA					
10/19/83	Portsmouth	Operating at a fire	Searching fire building for possible victims	Heart	53
WASHINGTON					
7/3/83	Seattle	Operating at a fire	Stretching a hose line in the street	Heart	19
WEST VIRGINIA					
5/23/83	Saint Marys	Operating at a fire	Directing fireground operations	Heart	48
6/30/83	Cairo	Operating at a fire	Stretching a hose line in the street	Heart	34

State	City	Type of Duty	Fireground Operation	Cause of Death	Age
WISCONSIN					
7/11/83	Monona	Responding		Multiple trauma resulting from apparatus being struck by a dump truck	41
WYOMING					
9/9/83	Sheridan	Flying air patrol checking for lightning caused fires at Big Horn National Forest		Multiple trauma from plane crash (USDA Forest Service)	31
WASHINGTON, DC					
11/12/83		Responding		Head trauma resulting from fall from apparatus	24

APPENDIX C

1983 MAJOR FIRES — INVESTIGATED UNDER COOPERATIVE AGREEMENT[1]

1. *Tank Farm Fire, Newark,* NJ
   Tank overfill ignited at an incinerator.

2. *William and Mary College Dormitory, Williamsburg,* VAFire in combustible concealed spaces, out of reach of sprinklers.Successful evacuation of all occupants.

3. *Apartment Complex, Dallas,* TX
   $5,320,000 loss — wood shingles caused conflagration.

4. *Boarding House, Worcester,* MA
   Seven deaths — open stairway, combustible interior finishlack of early detection and warning devices.

5. *DC-9 aircraft, Cincinnati,* OH
   Twenty deaths resulting from on-board fire while aloft.

6. *Ramada Inn, Fort Worth,* TX
   Five fatalities.

7. *Home for Retarded, Swanee,* GA
   Lack of institutional level protection, eight deaths.

8. *Travelmaster Hotel, Dayton,* OH
   One fatality — success story: retrofit doors and door closers prevented fire from entering guests' rooms.

9. *Silver Leaves Boarding House, Au Clair,* WI
   Six fatalities in a group home. Protected exit saves several lives.

10. *Shopping Mall, Brunswick,* GA
    Large area required large commitment of fire fighting resources.

11. *Shopping Mall, Denver,* CO
    Large area required large commitment of fire fighting resources.

12. *Fireworks factory, Bellport, L.I.,* NY
    Two fatalities: overstorage near manufacturing, violation of safe quantity/distance rules.

13. *Group Home, Cincinnati,* OH
    Seven fatalities.

14. *Buffalo,* NY
    Six fatalities — five of fire fighters — in a propane tank explosion (a seventh person died later).

Copies of full reports on these investigations are kept on file at:

The Office of Fire Data and Analysis
U.S. Fire Administration
Emmitsburg, MD 21727

and

Learning Resource Center
National Fire Academy
Emmitsburg, MD 21727

[1]Excerpts are published in such fire safety publications as Fire Journal and Fire Command.

APPENDIX D

LIST OF TABLES AND FIGURES

APPENDIX E

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